

CLIMATE CHANGE AND TOURISM

Maria Rellie B. Kalacas



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GLOSSARY

Acidification – Ocean Acidification (OA) is a term used to describe significant changes to the chemistry of the ocean. It occurs when carbon dioxide gas (or CO₂) is absorbed by the ocean and reacts with seawater to produce acid.

Aerosols – A substance enclosed under pressure and released as a fine spray by means of a propellant gas.

Air stagnation – Air stagnation is a phenomenon which occurs when an air mass remains over an area for an extended period.

Algal blooms – A rapid growth of microscopic algae or cyanobacteria in water, often resulting in a colored scum on the surface.

Amphibian – A cold-blooded vertebrate animal of a class that comprises the frogs, toads, newts, salamanders, and caecilians. They are distinguished by having an aquatic gill-breathing larval stage followed (typically) by a terrestrial lung-breathing adult stage.

Amplifying – Enlarge upon or add detail to (a story or statement).

Anthropogenic – Chiefly of environmental pollution and pollutants originating in human activity.

Avian – Relating to birds.

Bestowed – To give something as an honor or present.

Biodegradable – (Of a substance or object) capable of being decomposed by bacteria or other living organisms and thereby avoiding pollution.

Biodiversity – The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.

Biomimicry – The design and production of materials, structures, and systems that are modeled on biological entities and processes.

Biophilia – (According to a theory of the biologist E. O. Wilson) an innate and genetically determined affinity of human beings with the natural world.

Bleaching – Cause (a material such as cloth, paper, or hair) to become white or much lighter by a chemical process or by exposure to sunlight.

Boreal forests – Boreal forests are the earth's most common and overall largest land-based biome. Boreal forests are also known as taiga, a Russian word which

simply means swampy, moist forest. Boreal forests are coniferous and contain large amounts of evergreen trees.

Bungee Jumping – The sport of jumping off a very high bridge or similar structure, with a long elastic rope tied to your legs, so that the rope pulls you back.

Bushlands – Bushland is a blanket term for land which supports remnant vegetation or land which is disturbed but still retains a predominance of the original floristics and structure.

Canoeing – The sport or activity of paddling a light, narrow boat.

Canyons – A large valley with very steep sides and usually a river flowing along the bottom.

Carbon sinks – A forest, ocean, or other natural environment viewed in terms of its ability to absorb carbon dioxide from the atmosphere.

Cardiovascular Diseases – Cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke

Carnavalesque – The definition of carnivalesque is something similar to a carnival in that it is very disorganized, excessive or surreal.

Chicxulub impact – The Chicxulub impactor also known as the K/Pg impactor and (more speculatively) as the Chicxulub asteroid, was an asteroid 10 to 15 kilometers (6 to 9 mi) in diameter which struck the Earth at the end of the Cretaceous, approximately 66 million years ago, creating the Chicxulub crater.

Cliff – A steep rock face, especially at the edge of the sea.

Climatologists – The scientific study of climates, including the causes and long-term effects of variation in regional and global climates. Climatology also studies how climate changes over time and is affected by human actions.

Compaction – The process by which the porosity of a given form of sediment is decreased as a result of its mineral grains being squeezed together by the weight of overlying sediment or by mechanical means.

Conservation – Conservation is also the protection of plants, animals, and natural areas, esp. from the damaging effects of human activity.

Contaminate – Make (something) impure by exposure to or addition of a poisonous or polluting substance.

Contemporary – A person or thing living or existing at the same time as another.

Contingency – A future event or circumstance which is possible but cannot be predicted with certainty.

Convention – An agreement between states covering particular matters, especially one less formal than a treaty.

Coracles – A short, roundish boat made as of animal skins or canvas waterproofed and stretched over a wicker or wooden frame.

Coral reefs – Coral reefs are diverse underwater ecosystems held together by calcium carbonate structures secreted by corals. Coral reefs are built by colonies of tiny animals found in marine water that contain few nutrients.

Corals – A hard stony substance secreted by certain marine coelenterates as an external skeleton, typically forming large reefs in warm seas.

Correlation – A mutual relationship or connection between two or more things.

Corrosive – Substance that causes visible discoloration, destruction, or irreversible changes, in living tissue at the point of contact within four hours.

Cosmic Rays – A highly energetic atomic nucleus or other particle traveling through space at a speed approaching that of light.

Cryosphere – The cryosphere is those portions of Earth's surface where water is in solid form, including sea ice, lake ice, river ice, snow cover, glaciers, ice caps, ice sheets, and frozen ground.

Deforestation – The action of clearing a wide area of trees.

Degradation – The process in which the beauty or quality of something is destroyed or spoiled.

Den – A wild mammal's hidden home; a lair.

Depletion – Reduction in the number or quantity of something.

Deteriorate – Become progressively worse.

Deterred – To discourage or restrain from acting or proceeding.

Diminishing – Make or become less.

Dredging – To remove unwanted things from the bottom of a river, lake, etc. using a boat or special device.

Drought – A prolonged period of abnormally low rainfall, leading to a shortage of water.

Dugongs – A sea cow found on the coasts of the Indian Ocean from eastern Africa to northern Australia. It is distinguished from the manatees by its forked tail.

Dunes – A mound or ridge of sand or other loose sediment formed by the wind, especially on the sea coast or in a desert.

Dynamiting – Blow up (something) with dynamite.

Ecological system – An ecological system can be defined as the complex set of biotic and abiotic components which are interconnected with each other.

Ecosystem – An ecosystem is all the plants and animals that live in a particular area together with the complex relationship that exists between them and their environment.

El Nino – An irregularly occurring and complex series of climatic changes affecting the equatorial Pacific region and beyond every few years, characterized by the appearance of unusually warm, nutrient-poor water off northern Peru and Ecuador, typically in late December. The effects of El Niño include reversal of wind patterns across the Pacific, drought in Australasia, and unseasonal heavy rain in South America.

Elevations – Height above a given level, especially sea level.

Embed – To fix something firmly into a substance.

Endangered – (Of a species) seriously at risk of extinction.

Equilibrium temperature – The planetary equilibrium temperature is a theoretical temperature that a planet would be at when considered simply as if it were a black body being heated only by its parent star.

Eruption – An act or instance of erupting.

Felled – Having been cut or knocked down.

Fiction – Something that is invented or untrue.

Fjords – A long, narrow, deep inlet of the sea between high cliffs, as in Norway, typically formed by submergence of a glaciated valley.

Flood – An overflow of a large amount of water beyond its normal limits, especially over what is normally dry land.

Fluctuations – An irregular rising and falling in number or amount; a variation.

Foils – Prevent (something considered wrong or undesirable) from succeeding.

Foliage – Plant leaves collectively.

Fossil fuel – A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.

Frost-free season – Growing season, also called Frost-free Season, a period of the year during which growing conditions for indigenous vegetation and cultivated crops are most favorable. It usually becomes shorter as the distance from the Equator increases.

Gadgets – A small mechanical or electronic device or tool, especially an ingenious or novel one.

Gasoline – A volatile flammable liquid hydrocarbon mixture used as a fuel especially for internal combustion engines and usually blended from several products of natural gas and petroleum.

Geothermal – Relating to or produced by the internal heat of the earth.

Geyser – A gas-fired water heater through which water flows as it is rapidly heated.

Glacial – Denoting pure organic acids (especially acetic acid) which form ice-like crystals on freezing.

Glaciers – A slowly moving mass or river of ice formed by the accumulation and compaction of snow on mountains or near the poles.

Habitat – The natural home or environment of an animal, plant, or other organisms.

Habitation – Is the state of living somewhere.

Halons – Any of a number of unreactive gaseous compounds of carbon with bromine and other halogens, used in fire extinguishers, but now known to damage the ozone layer.

Harvest – The process or period of gathering in crops.

Hazardous – Risky; dangerous.

Haze – A slight obscuration of the lower atmosphere, typically caused by fine suspended particles.

Herbicides – A substance that is toxic to plants, used to destroy unwanted vegetation.

Humid – Marked by a relatively high level of water vapor in the atmosphere.

Hurricanes – Hurricanes are giant, spiraling tropical storms that can pack wind speeds of over 160 miles (257 kilometers) an hour and unleash more than 2.4 trillion gallons (9 trillion liters) of rain a day.

Incandescent – Emitting light as a result of being heated.

Incinerated – Destroy (something, especially waste material) by burning.

Indigenous – Originating or occurring naturally in a particular place; native.

Induce – Succeed in persuading or leading (someone) to do something.

Industrial revolution – Industrial revolution is defined as the changes in manufacturing and transportation that began with fewer things being made by hand but instead made using machines in large-scale factories.

Industrialization – Industrialization is the process by which an economy is transformed from primarily agricultural to one based on the manufacturing of

goods.

Inflated – Distended through being filled with air or gas.

Insulator – A substance which does not readily allow the passage of heat or sound.

Ionization – Ionization or ionization, is the process by which an atom or a molecule acquires a negative or positive charge by gaining or losing electrons to form ions, often in conjunction with other chemical changes.

Isotopes – Each of two or more forms of the same element that contain equal numbers of protons but different numbers of neutrons in their nuclei, and hence differ in relative atomic mass but not in chemical properties; in particular, a radioactive form of an element.

Kayaking – Kayaking is the use of a kayak for moving across water. ... A kayak is a low-to-the-water, canoe-like boat in which the paddler sits facing forward, legs in front, using a double-bladed paddle to pull front-to-back on one side and then the other in rotation.

Kilns – A furnace or oven for burning, baking, or drying, especially one for calcining lime or firing pottery.

King tide – A tide just after a new or full moon, when there is the greatest difference between high and low water; a spring tide.

Lagoons – A lagoon is a shallow body of water separated from a larger body of water by barrier islands or reefs.

Leisure travel – Leisure travel is travel in which the primary motivation is to take a vacation from everyday life. Leisure travel is often characterized by staying in nice hotels or resorts, relaxing on beaches or in a room, or going on guided tours and experiencing local tourist attractions.

Liquefied gas – Liquefied gas (sometimes referred to as liquid gas) is a gas that has been turned into a liquid by cooling or compressing it.

Littering – Make (a place or area) untidy with rubbish or a large number of objects left lying about.

Livestock – Farm animals regarded as an asset.

Magnitude – The great size or extent of something.

Malnutrition – Lack of proper nutrition, caused by not having enough to eat, not eating enough of the right things, or being unable to use the food that one does eat.

Meningitis – A serious disease in which there is inflammation of the meninges, caused by viral or bacterial infection, and marked by an intense headache and

fever, sensitivity to light, and muscular rigidity.

Mesmerizing – Capture the complete attention of (someone).

Meteorological – Relating to the branch of science concerned with the processes and phenomena of the atmosphere, especially as a means of forecasting the weather.

Migration – A seasonal movement of animals from one region to another.

Mitigate – Make (something bad) less severe, serious, or painful.

Mortality – The state of being subject to death.

Neurological – Relating to the anatomy, functions, and organic disorders of nerves and the nervous system.

Obliteration – To cause to disappear.

Ocean currents – An ocean current is a seasonal directed movement of seawater generated by forces acting upon this mean flow, such as wind, the Coriolis effect, breaking waves, cabbings, temperature and salinity differences.

Outcroppings – The part of a rock formation that appears above the surface of the surrounding land.

Oxidizer – An oxidizer is a type of chemical which a fuel requires to burn.

Paleoclimate evidences – Paleoclimatology is the attempt to reconstruct ancient climates and their causes.

Pattern – A regular and intelligible form or sequence discernible in the way in which something happens or is done.

Penetration – A movement into or through something or someone

Perpetuate – Make (something) continue indefinitely.

Pesticides – A substance used for destroying insects or other organisms harmful to cultivated plants or to animals.

pH level – A pH value is a number from 1 to 14, with 7 as the middle (neutral) point. Values below 7 indicate acidity which increases as the number decreases, 1 being the most acidic.

Photosynthesis – The process by which green plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water.

Pilgrimage – A journey, especially a long one, made to some sacred place as an act of religious devotion.

Poaching – The illegal practice of trespassing on another's property to hunt or steal game.

Precipitation – Water that falls from the clouds towards the ground, especially

as rain or snow.

Pristine – In its original condition; unspoilt.

Propellant – An explosive substance or fuel that causes something to move forward.

Psychological – Of, affecting, or arising in the mind; related to the mental and emotional state of a person.

Radiation – The emission of energy as electromagnetic waves or as moving subatomic particles, especially high-energy particles which cause ionization.

Rappelling – The act or method of moving down a steep incline or past an overhang by means of a double rope secured above and placed around the body, usually under the left thigh and over the right shoulder, and paid out gradually in the descent.

Recreational – Relating to or denoting activity done for enjoyment when one is not working.

Refrigerant – A chemical substance that can be used to make or keep things cold.

Refugees – A person who has been forced to leave their country in order to escape war, persecution, or natural disaster.

Repercussion – An unintended consequence of an event or action, especially an unwelcome one.

Salinity – The concentration of dissolved salts in water, etc., usually expressed in parts per thousand by weight.

Scarcity – The state of being scarce or in short supply; shortage.

Scuba-diving – The sport or pastime of swimming underwater using a scuba.

Sedimentary rocks – Sedimentary rocks are types of rock that are formed by the deposition and subsequent cementation of that material at the Earth's surface and within bodies of water.

Sequestration – The action of sequestering or taking legal possession of assets, the action of chemically sequestering a substance.

Silting – Sand or soil that is carried along by flowing water and then dropped, especially at a bend in a river or at a river's opening.

Simulation – Imitation of a situation or process.

Sinkholes – A cavity in the ground, especially in a limestone formation, caused by water erosion and providing a route for surface water to disappear underground.

Skiing – The action of traveling over snow on skis, especially as a sport or recreation.

Snorkeling – Snorkeling is the practice of swimming on or through a body of water while equipped with a diving mask, a shaped breathing tube called a snorkel, and usually swimfins.

Snow Making – Snowmaking is the production of snow by forcing water and pressurized air through a “snow gun,” also known as a “snow cannon,” on ski slopes. Snowmaking is mainly used at ski resorts to supplement natural snow.

Snowboarding – The sport or pastime of sliding downhill on a snowboard.

Sprawling – Spread out over a large area in an untidy or irregular way.

Submerge – Cause (something) to be under water.

Supernova – A star that suddenly increases greatly in brightness because of a catastrophic explosion that ejects most of its mass.

Swamps – An area of low-lying, uncultivated ground where water collects; a bog or marsh.

Terrestrial – On or relating to the earth.

Thermal expansion – Thermal expansion is the tendency of matter to change in shape, area, and volume in response to a change in temperature.

Thermostat – A device that automatically regulates temperature, or that activates a device when the temperature reaches a certain point.

Toasty – Comfortably warm.

Tornadoes – A mobile, destructive vortex of violently rotating winds having the appearance of a funnel-shaped cloud and advancing beneath a large storm system.

Transmission – The process of broadcasting something by radio, television, etc., or something that is broadcast.

Trekking – Go on a long arduous journey, typically on foot.

Troposphere – The lowest region of the atmosphere, extending from the earth’s surface to a height of about 6–10 km (the lower boundary of the stratosphere).

Tumbling – Fall suddenly, clumsily, or headlong.

Typhoons – A tropical storm in the region of the Indian or western Pacific oceans.

Urbanization – The process of making an area more urban.

Variation – A change or slight difference in condition, amount, or level, typically within certain limits.

Volcano – A mountain or hill, typically conical, having a crater or vent through which lava, rock fragments, hot vapor, and gas are or have been erupted from the earth's crust.

Vulnerable – Exposed to the possibility of being attacked or harmed, either physically or emotionally.

Whitewater rafting – White-water rafting is the activity of riding on a raft over rough, dangerous parts of a fast-flowing river.

Wildfire – A large, destructive fire that spreads quickly over woodland or brush.

PREFACE

The book “Climate Change and Tourism” deals with an important topic that is very much essential to this world now. Climate plays an important part in the existence of this planet and we humans either forget this or ignore this out of arrogance. But mother Earth does not always forgive our mistakes and that is the reason we see so many deaths and destructions occurring due to various climatic hazards. It is by the sheer ignorance of humanity that ‘Climate Change’ has become such an alarming term today.

Many factors induce Climate Change and in a similar way, Climate Change also has an influence upon many things. Among the many influences, this book talks about the link between Climate Change and Tourism since both are growing day by day. Climate Change, as well as tourism, are both big areas that needs more research and deep analysis to understand the reality in them. Climatic condition of a place and Tourism are so well connected that they always complement each other.

This book is structured in a way that, first readers will understand more about climate and the history of climate change over these years. The trend in Climate over the past years is explained and the future possibilities are also shown. Then the highlight is given on how climate is linked to tourism industry and why it is of so much importance to the tourism sector. The first two chapters speak about all these subjects in detail with data facts and examples. The subsequent chapters will enlighten you on how climate change occurs and what are the contributing factors.

A separate chapter is dedicated for ‘Global Warming’ because it is an important topic and the readers must get all possible information about it. This chapter is designed with the intention that it should cause an effect on the readers and they have to contribute whatever is possible to stop Global Warming. The negative impacts of climate change are also explained by providing examples of tourist destinations that are becoming extinct.

The initial chapters of the book talks about the impact of Climate change on tourism industry in both positive and negative ways. The impact of Climate change on many other industries and sectors like agriculture, environment, health, etc., to how it affects the economy of nations are also explained clearly.

The latter part of the book does a reverse study and discusses the ways by which tourism industry is seen as a contributor to Climate Change. It also checks whether tourism is only a business with no care for environment. After analyzing both sides carefully, we finally look at ways and learn how a climate-friendly tourism can be build and the necessary actions that need to be taken for that to happen. The last chapter of the book deals with all the Policy regulations that have come up till date to reduce Climate change and how far our Leaders are supporting to this cause and what plans they have laid out to monitor the change in order to save our Planet from burning into ashes.

Overall this book will make you travel the entire world and will show you the unknown side of ‘Climate Change through an interesting connection called ‘Tourism.’

CHAPTER 1

INTRODUCTION

“Though we travel the world over to find the beautiful, we must carry it with us, or we find it not.”

—Ralph Waldo Emerson

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Climate is one of the very essential factors for the existence of this world. The varying Climatic conditions pose a great threat to the world today. Many scientists are extremely cautious and are continuously working to identify even the slightest change in the atmosphere to prevent any major disasters from happening. As of how humans look forward to good climate, they look for good tourist places also. Climate and tourism complement each other so well. We all know that a good weather and climate changes the mood of a person and brings positivity in him. As we humans are evolved from nature, we basically are attracted to nature's most wonderful things. This is the main reason why tourism exists and why people prefer tours. In this Chapter, we are going to learn more about the meaning of Climate and the changes in climate and how tourism and climate are linked with each other. Also, this chapter will focus more on the trend in climatic conditions in the past, present and future. We will also discuss the outcomes of the existence of tourism where the climatic conditions are alarmingly becoming dangerous.

1.1. CLIMATE CHANGE: MEANING AND REASON FOR OCCURRENCE

We all know that Climate is something that is embedded in our day-to-day activities. A basic conversation between two people will not get over without enquiring about the weather conditions of their place. This shows the significance of climate but many of us do not recognize this although we talk more about it. Sometimes there is a confusion among many of us as to whether climate and weather are the same or different. In order to understand the topic better, we will first make ourselves clear with all the basics.

1.1.1. What is the Difference between Weather and Climate? Are They the Same?

Weather is something that is felt by us at a particular time or a day and it changes constantly. The weather of a place may be hot one day and it may be rainy the next day. Climate is the usual weather experienced in a place just like summer and winter. All in all, Climate is the average weather of a place or a region. For example, the Climate of Antarctica is freezing cold. When we talk about the climate of the Earth, it means the combination or the average of all the climates of different parts of the world and any change is it in a negative way is considered dangerous to all the species of this earth.

Let us learn more about Climate change.

1.1.2. Change in Climate

According to Scientists, the climate of the Earth is always changing; although it takes hundreds of years for the Earth's climate to change, it still is changing. A change in the climate means a change in the usual temperature of the Earth or it may be a change in the amount of rainfall or snow that the Earth receives. It may be a change in the usual pattern of weather. When we go by the definition of climate as stated in the earlier section, a climatic change means a change in the average weather of a place or a region. It is also the change in the statistical distribution of weather patterns and these climate changes last to a certain period, say for decades or thousands of years.

According to the Intergovernmental Panel on Climate Change (IPCC), '*Climate Change*' means *a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period.*

Climate change is not something new. Climate is always changing and there are evidences to prove that the climate of the Earth has been very high as well as low in the past. It is said that the temperature of the Earth has increased by one degree Fahrenheit in the last 100 years. By seeing the numbers it may not seem to be much of an increase but the truth is that even a slight change in the Earth's temperature can induce big effects (Figure 1.1).



Figure 1.1: Picture representing the possible change of earth due to climate change, (Source: <http://www.progressivereform.org/CPRBlog.cfm?idBlog=7B03724F-9A9D-52A9-B129052D8715869C>).

People involved in the study of Earth have shared that the Earth is getting warmer. Though Earth has been warmer in the past decades, the alarming fact is the rate at which the change occurs and this is the main reason why Climate change is looked as a great threat to humanity now.

1.1.3. Reasons for Climate Change

When we talk about Climate change it means a long-term change in the weather conditions. Examples of some changes are change in rainfall patterns, rise, and fall of temperature, flow of wind, etc. A change in the Earth's climate does not occur suddenly or due to one reason. There are many factors that trigger climate change. Factors that can change the shape of climate are called the 'Climate forcings' or 'forcing mechanisms.' The Climate forcings can be either 'internal' or 'external.' Internal climate forcings means the changes caused due to the natural process that occurs in the climatic system itself. External forcings can be either natural or caused by other external factors like humans.

The Figure 1.2 lists out some of the main reasons for the change in climatic condition, in other words, the 'Forcing Mechanisms.'

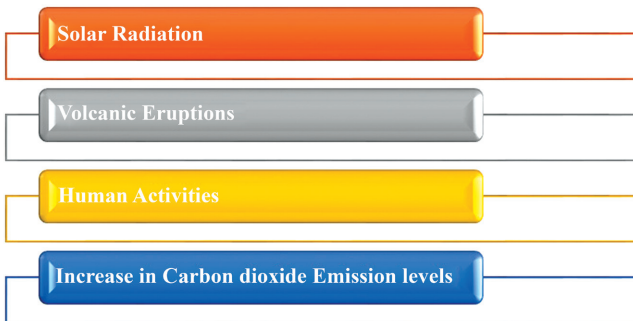


Figure 1.2: Forcing mechanisms for climatic change.

1.1.3.1. Solar Radiation

Variation in Solar radiation is one of the forcing mechanisms of climatic change. It is well known that the Cosmic rays from Sun fall on Earth and this has considerable effect on Earth. These Cosmic rays are an influx of ionized particles and an increase in the Cosmic rays would increase the ionization in the Earth's atmosphere leading to a greater formation of clouds. This tends to cool the surface of the Earth (Figure 1.3).

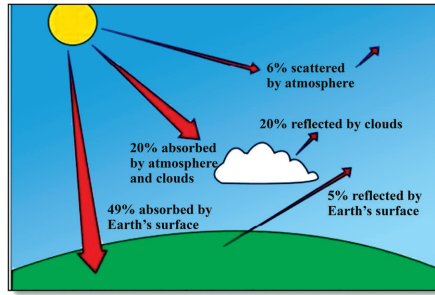


Figure 1.3: Picture illustrating solar radiation, (Source: <http://legacy.science-learn.org.nz/Contexts/Icy-Ecosystems/Sci-Media/Images/The-greenhouse-effect>).

The amount of Cosmic rays falling on Earth from the Sun depends upon the distance between the Sun and the Earth. When this distance changes, there will be a change in the temperature level. In fact, the speed in which the energy is received from the Sun and the rate at which it spreads into space determine the equilibrium temperature and climate of Earth. This energy is carried out across the globe by means of winds, ocean currents, and other mechanisms. Activities in the galaxy such as Supernova event, the solar system passing through a dense interstellar cloud or the oscillatory movement of the Sun's position with respect to the galactic plane can all have its effect on the Earth's climate.

1.1.3.2. Volcanic Eruptions

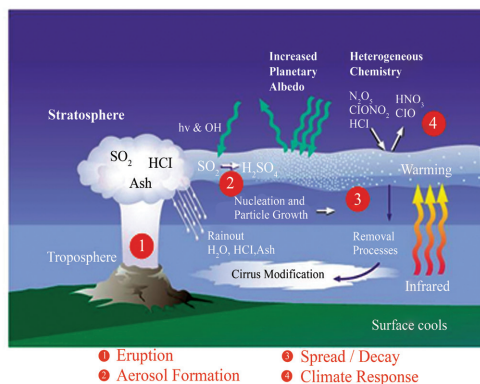


Figure 1.4: Effects of volcanic eruptions on climate, (Source: https://www.windows2universe.org/earth/climate/geosphere_volcanoes_influence_on_climate.html).

The continuing Volcanic eruptions is considered to be one among the reasons for the change in Climatic conditions. The Volcanic eruptions that eject over hundred thousand tons of Sulphur dioxide into the Stratosphere are capable of changing the Earth's climate. Sulfur dioxide and Sulfate aerosols have the ability to absorb or scatter solar radiation and they create a layer of Sulphuric acid haze on the atmosphere (Figure 1.4). This kind of volcanic eruptions occur a number of times in a century and the layer thus formed blocks the transmission of solar radiation to the Earth resulting in cooling.

1.1.3.3. Human Activities

Many studies on climatic changes have now recorded that certain human activities are the primary causes for ongoing climatic change. Scientists use various methodologies to understand past, present and future climate. The data (in this case temperature) is gathered from various sources like deep accumulated ice, flora and fauna, analysis of sediment layers and stable isotopes, glacial and periglacial processes and more importantly past sea level records. General circulation models are often used in theoretical approaches to match past climate data, make future projections, and link causes and effects in climate change.

The World Meteorological Organization (WMO) coined the term, 'Climatic Change' in the year 1966 to include all kinds of climatic changes that are occurring for more than 10 years regardless the cause. But in 1970, this term was changed into 'Climate Change' to focus mainly on the anthropogenic causes as it became evident that the activities carried out by humans had the potential to alter the climate drastically. The term 'Climate Change' gained importance as it was incorporated in the title of Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC).

UNFCCC defines Climate Change as, "*a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural variability observed over comparable time periods.*"—UNFCCC, 1994

The term 'Climate Change' is now used as a noun to describe the problem as well as in technical terms. The significance of this terminology is to emphasize to the world that polluting the Earth's atmosphere would lead to unpredictable weather conditions. Human activities cause a lot of pollution. The best example is the air pollution caused by industries. It is to

be noted that humans are the major contributors for climate change and the damage that they cause to the Earth is irreparable (Figure 1.5).



Figure 1.5: Various human activities that causes climate change, (Source: <https://helpsavenature.com/what-causes-global-warming>).

The United States National Research Council states that there is enormous proof that climate change in large part is caused by humans. Right from cooking to driving cars, human beings use energy to their daily needs. They create energy by burning gas, oil or by burning coal and these things when burn produce smoke in the air and this brings up heat and overheating can cause change in the climate of a place. When more and more fuel is used, there will be a variation in the Earth's climate.

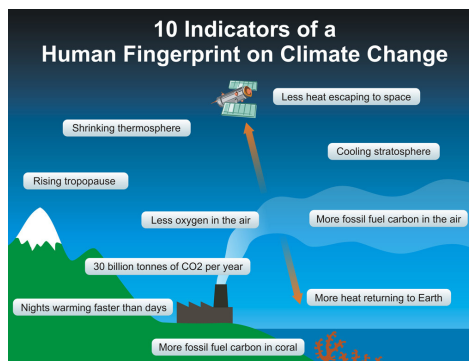


Figure 1.6: Impact of human activities on climate, (Source: <https://www.vox.com/science-and-health/2017/6/1/15724164/9-questions-climate-change-too-embarrassed-to-ask>).

The mechanisms that humans follow in their industries causes emission of various greenhouse gases and these greenhouse gases trap the radiation of the Sun in the atmosphere contributing to Global Warming. More than 97% of the scientists agree that last century faced a change in the global climate due to anthropogenic activities (Figure 1.6).

Humans are said to be the cause for increase in the Carbon dioxide level in the atmosphere today. We will discuss more about it in the below section.

1.1.3.4. Increase in Carbon dioxide Emission Levels

One of the most important harm that humans cause to the atmosphere is the increase in level of Carbon dioxide. Carbon dioxide is a colorless gas which is produced just by breathing. The discharge of Carbon dioxide has been on the increase since the time of industrial revolution and there are also many other greenhouse gases which are the outcomes from fuel usage and they all have combined and lead to a phenomenon called global warming. The Carbon dioxide gas has the ability to absorb the infrared light and is one of the contributing factors to the warming of atmosphere. Once these gases come out, they will remain in the Earth's atmosphere for hundreds of years and can cause seasonal changes over a period of time (Figure 1.7).



Figure 1.7: Warming of earth's atmosphere, (Source: <https://theoldspeakjour->

nal.wordpress.com/2014/05/08/what-does-it-mean-to-do-something-about-climate-change/).

Right from the period of industrial revolution, fossil fuel has been consumed by human beings for power generation; deforestation was carried out for agriculture and urbanization and many such things. Due to all these activities, the Carbon dioxide level in the atmosphere increased by 40%. The concentration of Carbon dioxide in the atmosphere rose from 280 parts per million in the pre-industrial period to 402 parts per million in 2016 (Figure 1.8).

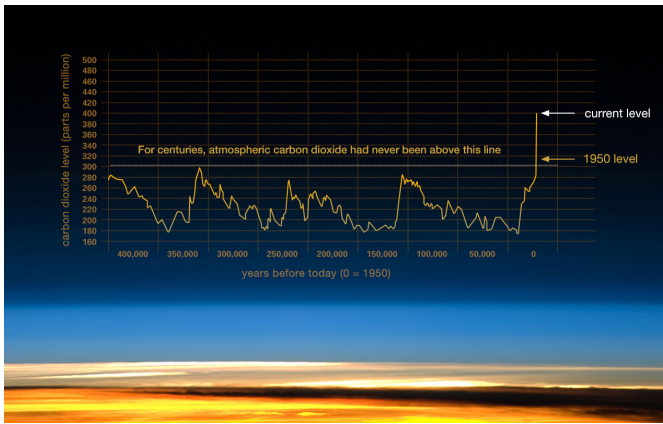


Figure 1.8: Increase in atmospheric carbon dioxide level, (Source: *Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO₂ record*).

The above graph is based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements and this is indeed an evidence to prove that atmospheric CO₂ has increased since the Industrial Revolution. Ninety percent of the reason for global warming for the past 15 years is predicted to be the resulting action of human activities. This has proved that the Climate change is the outcome of human behavior.

Due to all these factors, there is a rise in temperature. The world has already started to experience the consequences. Rising sea levels, warming of coastal waters, change in rainfall patterns, melting of ice in the polar regions like Greenland, Antarctica which also results in the increase of sea level are all examples of change in the climatic conditions. This continues as a chain reaction as one has impact on another. For example, the increase in sea level due to melting of ice causes harmful fluctuations in the ocean currents. It is astonishing to see the change in the timing of blossoming of

some flowers and growth of trees. Even in earlier times, climate change has resulted in extinction of many plant and animal species and appearance of new ones (Figure 1.9).



Figure 1.9: Melting of ice in polar regions due to rise in temperature, (*Source: <http://growinglines.com/issues/climate-change-and-natural-disasters/>*).

The Intergovernmental Panel on Climate Change (IPCC) has stated that many changes observed in the atmospheric temperature and oceans during the 20th Century are because of anthropogenic climate change. Hazards of climate change is equal to everyone and to each region. Flooding in Maldives and destruction caused by hurricanes in Western America have the same reasons as they form part of the same ecological system. Warmer air is the root cause for both these occurrences. The nature of problem may differ from place to place but the underlying root cause is the same. Global temperatures are rising and since warm air is capable of holding far greater quantities of water, due to higher evaporation rates, storms and other extreme climatic occurrences have become more frequent and intemperate.

The study on climate is given such an important because it has the power to destroy the lives of people today and this will also continue for future generations. A thorough analysis and understanding on this subject is required so that every nation and the people in authority will place Climate change along with other challenges that the world faces. The climate of Earth is a complex subject and to study it, a thorough analysis is required. Any damage caused to the atmosphere takes a long time to recover and that is why climate change is talked about as a serious issue. For instance, there is proof that the Chicxulub impact that occurred some 66 million years

ago had caused a vast change in the Earth's climate. Huge quantities of Sulfate aerosols that got mixed up in the atmosphere decreased the overall temperature up to 26 °C and caused a sub-freezing temperatures for a lengthy period of 3 to 16 years. It took more than 30 years for the earth to recover from this event.

It is estimated that climate change is occurring ten times faster than at any time in the past 65 million years. Since many factors are contributing to our planet's climate, scientists are much worried about the stability of the climate. Having understood the importance of climate in the natural ecosystems and for existence of humanity, these factors must be kept under control. Failing to do so will eventually lead to the destruction of Mother Earth.

1.2. LINK BETWEEN CLIMATIC CONDITIONS AND TOURISM

From what we have learned so far, we are sure that Climate Change is a great challenge to the world and it has an impact on almost everything. Although many industries are affected due to Climate Change, the one industry that has significant connection and has high impact with climatic condition is the tourism industry.

The Travel and Tourism industry is one of the fastest growing industries in the world. Tourism industry depends on climate on a high level and it just cannot ignore even the slightest change. The important reason for a tourist to get attracted to a place is its natural beauty and the prevailing climatic conditions. People will not spend their money to suffer in extreme and unpredictable weather conditions nor they will visit places that does not entertain them. The choice of destination largely depends upon the climate of the place and this is the reason why tourism flourishes in countries with best climate.

Even the World Tourism Organization acknowledges the fact that weather and climate influence the choice of leisure travel destinations. For booking ski trips or for planning beach vacations, people first look for the apt weather even before checking on cost. The tourism websites of today are forced to provide the projected weather condition to ease travel planning of tourists. The websites that do not provide such information cannot be in the business for long run as users will go to other sites that provide such vital information (Figure 1.10).



Figure 1.10: Tourists in Peru, (Source: <http://www.dosmanosperu.com/news/54-tourist-arrive-peru-come-asia-pacific-region/>).

Business travelers rely much on climate as any delay or diversion may hinder their business trip causing loss. The World Tourism Organization states that “in today’s world, accurate geographically specific meteorological information is essential for tourism operations more than ever in the history of tourism.” In most cases, climate of a place decides the length of stay of tourists. Many tourist activities are planned based on the length of the season. If the climatic condition is good and is as usual then the tourism industry grows.

Quite surprisingly tourism is one of the contributors to climate change and tourism is the industry that also gets affected very badly whenever there is a climate change. A change in climate in a particular destination leads to less to no turn over of tourists. California’s Lake Tahoe region can be quoted as an example of how climate change can affect tourism (Figure 1.11). Mike Hower, a reporter from GreenBiz states it as, “A lack of snowfall tied to California’s climate change-perpetuated drought led to several years of record-low attendance at ski resorts, which in turn harmed restaurants, hotels and other businesses accustomed to servicing customers drawn by snowsports.”



Figure 1.11: Change in the quality of water in Lake Tahoe due to climate change, (Source: <http://lauren-steely.strikingly.com/>).

The change in Climate does not only affect the tourism industry but all the other industries associated with it. Hower further states that “While businesses in the tropics might enjoy longer beach seasons, warmer temperatures in the mid-latitudes could reduce tourists’ motivation to travel there, opting instead for nearby destinations, according to the World Meteorological Organization.” Climate change poses a shift in the outdoor activities and winter sports. The increasing sea level and the rising temperatures are damaging the natural attractions where tourists throng in huge numbers. Along with the changes in the rising water levels, the emission of Carbon dioxide and ocean acidity are altering the ecosystem causing considerable damage to the species in water like jellyfish, algal blooms, and cyanobacteria which is a great risk for coastal tourism. As coastal tourism represents the largest segment of the tourism industry, the flow of tourists have already started reducing due to the altering weather patterns. The ski resorts are also at risk of losing their business as the snow in the mountain regions are considerably decreasing. Climate change mainly affects the environmental resources that serve as tourist attractions. Nature-based tourism, in particular, is highly sensitive to environmental changes caused due to climate change (Figure 1.12).



Figure 1.12: Ski resorts facing loss due to shortened season, (Source: http://www.dailymail.co.uk/travel/travel_news/article-3377295/Alps-ski-resorts-lower-altitudes-suffer-lack-snow-leaving-slopes-bare.html).

Although there are many causes inducing climate change, tourism is also considered one among them. In order to make the tourist destinations more attractive and comfortable for tourists more energy is utilized for building infrastructure. These energy and resource consumptions add pressure to the local ecosystem. Transportation is another important element of air pollution. Tourism business cannot survive without transportation. Tourists are to be carried to and from the destinations. According to the International Air Transport Association (IATA), 2% of carbon emission worldwide is caused from transportation. A United Nations Report on climate change and tourism states that “Tourism is responsible for about 5 % of global greenhouse gas emissions.”

As climate and tourism are so bound to each other, tourism industry can flourish by adopting climate-friendly management systems. Travelers can be made more responsible to support the ecosystem so that the rest of the world too can enjoy the places as they do.

1.3. CLIMATIC CHANGE TREND OVER THE PAST YEARS

We often hear that the Climate of the Earth is always changing and now it is more often than the past. But this is not a sudden occurrence; changes in the climatic conditions are prevailing from a very long time. It is said that

in the last 650,000 years, there has been seven cycles of glacial advance and retreat; the last ice age was some 7000 years ago and the end of this ice age marked the beginning of the modern era of human civilization. But how do we know all these as science says that the Earth was formed some 4.5 billion years ago? To understand the climate trend we should be able to know the climate data of the past. How do we know the climate of a particular place some thousand or millions of years ago? The secret is that there are clues left which still remains in layers of sedimentary rocks, rings of trees, coral reefs, fossils, and ocean sediments.

These ancient evidences also known as the paleoclimate evidences reveals that the rate at which the atmosphere is warming up is almost ten times faster than the average rate of ice-age-recovery warming. The ice cores taken from Greenland, Antarctica and Tropical Mountain glaciers reveals that the climate of the Earth is highly influenced by the greenhouse gas levels. There were times when the Earth was covered with ice and also times when it was very warm. The below graph highlights the very old data of the ups and downs of temperature and Carbon dioxide levels in the earth's atmosphere (Figure 1.13):

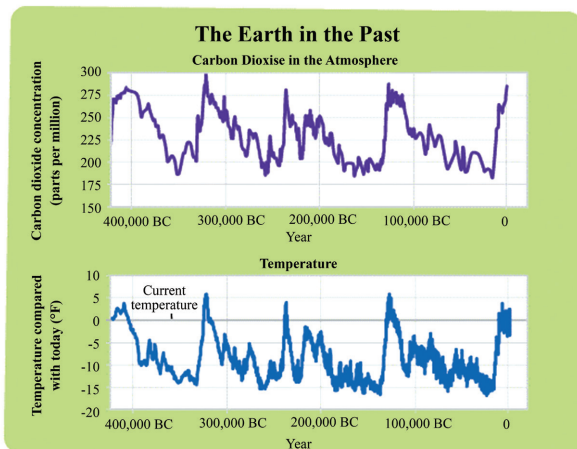


Figure 1.13: The earth in the past, (Source: EPA's *Climate Change Indicators* (2016) and Petit et al. (2001)).

The above graph does not include the Carbon dioxide and temperature rise caused by humans in the recent times. It was thousands or millions of years ago and it is quite obvious that humans are not the reason for this change and there must have been other natural reasons. If it was today then

there will be no denying fact that the changes are caused mainly due to the activities of humans. But the graph makes a clear mention that there is a strong connection between level of Carbon dioxide and temperature.

There has been many shifts in the Earth's climate both from natural and artificial ways. Based on various studies conducted by scientists for past several decades and using different sets of data and technology, they have come to a conclusion that the climate is changing permanently. The satellites that are monitoring each activity of Earth and with the technological advancements, scientists are able to collect a lot of information. With the information collected over a number of years, they are able to confirm the climate change in the past years and the trend in which it changes. In order to prove this, the scientists focus on some important changes and trends that has occurred in the past fifty years. Let us look at each of the climate change trend deeply (Figure 1.14):

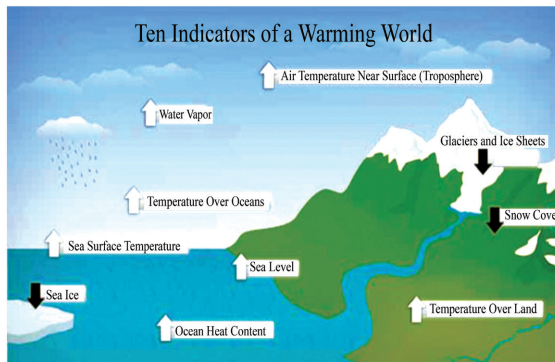


Figure 1.14: Indicators of a warming world, (Source: <https://www.ncdc.noaa.gov/climate-information/climate-change-and-variability>).

1.3.1. Rise in Temperature

There has been a lot of changes in the Earth's climate over the past years, the main one being the warming up of atmosphere. Studies show that the average temperature of the Earth's surface has increased by about 0.8C (1.4F) in the last 100 years and in this 0.6C i.e., 1.0F increase has occurred in the last three decades alone. An increase in 1° F does not seem to be much high but according to experts even a small change in the Earth's temperature leads to huge impacts.

Although the Earth's surface has seen high temperatures even before thousands of years, the current trend is seen with importance because

it's very likely that from the mid of 20th Century more than 95% of it is probably caused by human activities. Most of the increase in temperature has happened in the past 35 years with 16 of the 17 warmest years on record occurring since 2001. The rate of warming has increased in the mid-1970s.

Britain recorded it's highest temperature of 38.5° C in 2003 and this increase in temperature lead to the death of two thousand people. Not only in Britain, even in U.S, the recording of high temperatures are on the increase from 1950. It was identified that the years 2014, 2015 and 2016 were ultimately the hottest years ever recorded. The months starting from January to September in 2016 except June were recorded as the warmest months. In fact, a study published in Science journal in June 2015 doubted there had been a warming hiatus in the first place. As per reports from UN weather body, man-induced global warming and El Nino oceanic phenomenon made years 2011 to 2015 to be the warmest five-year period on history. The increase in temperatures may create records but these are not a good sign for our planet. The scorching temperatures which were once considered abnormal are becoming quite common now.

Increase in temperature produce heat waves and it affects everyone. According to a study conducted by Camilo Mora, an academic at the University of Hawaii, almost 48% of people will be at the risk of extreme heat waves by the year 2100. Mora has told The Guardian, "Dying in a heatwave is like being slowly cooked, it's pure torture. The young and elderly are at particular risk, but we found that this heat can kill soldiers, athletes, everyone." People are becoming more exposed to these heat waves and this causes health hazards and at extreme conditions even cause death. Every year many people in India and Pakistan die during summer due to heat waves (Figure 1.15).

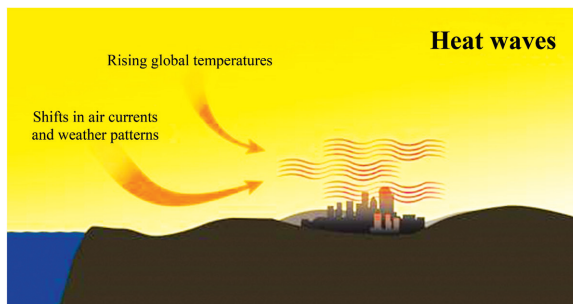


Figure 1.15: Heat Waves Caused Due to Rise in Temperatures, (Source: <https://kneebees.com/blogs/kneebees-knee-pads/are-you-protecting-yourself-properly-during-a-heat-wave>).

Heat waves also cause wildfire in forests (Figure 1.16). Many forests are destroyed every year due to the fire caused by extensive heat. Many other parts of the world are also experiencing such situations. Even people in China faced extreme heat during October 2015 and in Africa, the situation is even worst. Observations made via satellites and measurements taking directly points out that the last decade has been the most warmest. In the last fifty years, alone temperatures have actually doubled. It is this increase which has become a cause of concern for the scientists.



Figure 1.16: Wildfire in Portugal, (Source: <http://www.euronews.com/2017/06/18/what-impact-did-climate-change-have-in-portugal-s-deadly-wildfire>).

One of the main reason for the increase in atmospheric temperature is due to human activities particularly burning of fossil fuels. The increase in the greenhouse gases warms up the lowest layer of the atmosphere called the troposphere.

1.3.2. Melting of Ice and Increase in Sea Level

The rise in overall temperature has other impacts also. As per data facts gathered through satellite, on an average, there has been an increase of some 3mm in the sea levels over the past few decades. In the last century, the global sea level rose to about 8 inches. But when we see the rate of increase in the last two decades, it is approximately double than that of the last century. Thermal expansion also causes this increase in a greater way. The rise in overall temperature causes the seawater to warm up and when the sea water warms up, the molecules present in them lose their density and this causes an increase in the volume (Figure 1.17).



Figure 1.17: Remote villages on the Solomons where the sea level increases every year, (Source: <https://english.kyodonews.net/news/2017/11/9ef20f2d3394-focus-solomon-island-villages-shrinking-due-to-rising-sea-levels.html>).

There are also other reasons for the increase in sea level. Due to extreme heat, the mountain glaciers and the polar ice are melted. The ice class of the Arctic and Antarctic regions are melting rapidly. Satellite records show a decline in the sea-ice in the Arctic regions from year 1979, that too at an annual rate of 4% per decade. Since the Carbon dioxide level in the atmosphere is increasing, the radiation caused by it is absorbed by the Arctic ice and hence they are melting at a faster pace. All these ice from the Arctic and Antarctic region melts and moves into oceans causing increase in the global sea levels and also cause floods in the coastal regions (Figure 1.18).



Figure 1.18: Melting of Antarctic ice leading to increase in Californian coast sea level, (Source: <https://www.youtube.com/watch?v=kYiZbpC15ko>).

Only 30% of water in the Earth is fresh, rest all is frozen water. Normally the Arctic ice cap grows each winter due to less sunlight and then shrinks in summer. This is the usual pattern but now due to increase in temperatures, shrinking happens more often. The sea ice of the Arctic Ocean had started to decrease significantly from 1987 and it continues throughout the year and more during summers. Some studies suggest that the Arctic Ocean could lose all of its ice cover by the year 2100 but many believe that it may happen even much before that. If the same situation persists then Arctic and Antarctic regions will not remain as the coldest place on the Earth.

According to Tor Eldevik, a professor at the Bjerknes Centre for Climate Research at the University of Bergen in Norway, the sea ice may disappear in the Arctic Ocean in another forty years. Even a slight increase of two degrees has a 39% risk of vanishing the ice from the Arctic Ocean during summer. In Greenland and Antarctica, the body mass of the ice sheets are decreasing. There has been a reduction in the ice sheets of Greenland and West Antarctica since 1990. NASA's Gravity Recovery and Climate Experiment shows that Greenland has lost 150 to 250 cubic kilometers of ice per year during the period 2002 to 2006 and Antarctica has lost 152 cubic kilometers of ice between 2002 and 2005. The vast spread of snow covering the Northern Hemisphere has decreased over the past five decades. Eight of the ten largest cities in the world are near coast and increase in sea level means the lives of the people living in those cities are at higher risk. As the salt water intrudes into fresh water, marine life is also in great threat. There is so much stress to the marine ecosystem.

Snow and ice are two most important defense systems for our planet. It controls the amount of Sun's energy absorbed by the Earth. Snow and ice help in reflecting the Sun's energy back into space thereby keeping the planet cool. As the rise in temperature causes meltdown of snow and ice, there is only dark land and ocean left out both of which absorbs heat. This means that without snow and ice, Earth will absorb more solar energy (Figure 1.19).

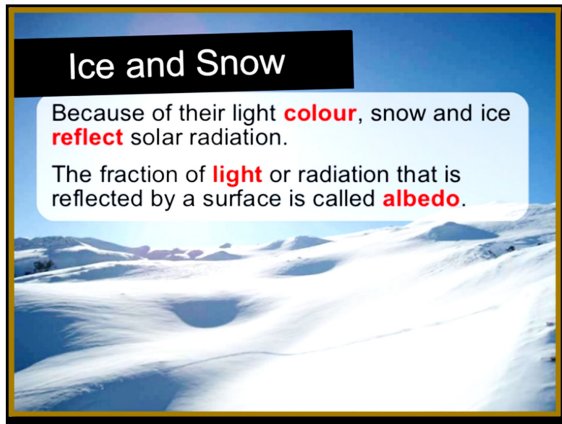


Figure 1.19: Snow and ice protect earth from solar radiation, (Source: <https://www.slideshare.net/OhMiss/earths-climate>).

Climate change has its effect on glaciers as well. Glaciers across the world including the ones found in the Himalayas, Alps, Rockies, Andes, Africa and Alaska are already retreating. Shrinking of mountain glaciers have contributed to the increase in sea level since 1850. From 1990, there was significant increase in the melting down of glaciers. Glacier mass stays balanced when the ice that is getting evaporated during summer is fully replaced by snowfall in winter. But when more ice melts with no full replacement then the glacier loses its mass. This affects the life of people who depend on melting ice for water for farming and other daily activities.

The Himalayan Glaciers which are the source of some of the biggest rivers of Asia may disappear by 2035 if the present climate change continues. The glaciers that melt move 100 times faster than normal rate. The Gangotri glacier in India which is the base for one of India's largest river basins is receding at an average rate of 2.3 meters per year. According to experts if this is to be the same then the biggest river Ganges will become a seasonal river, largely dependent on monsoon rains (Figure 1.20).



Figure 1.20: Image of Gangotri Glacier, (Source: <http://slideplayer.com/slide/6434597/>).

1.3.3. Ocean Acidification

The acidity of the surface ocean waters have increased ever since Industrial Revolution started. The Carbon dioxide in the atmosphere is observed by the oceans and increase in Carbon dioxide emission impacts oceans largely. It is analyzed that the amount of Carbon dioxide absorbed by the upper layer of the oceans is increasing at a rate of 2 billion tons per year (Figure 1.21).

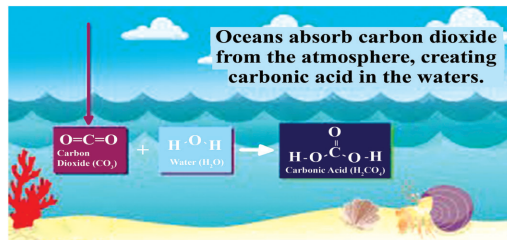


Figure 1.21: Ocean acidification process, (Source: <https://www.epa.gov/ocean-acidification/understanding-science-ocean-and-coastal-acidification>).

The acidification of oceans create harm for the marine creatures also. The Carbon dioxide in the atmosphere is absorbed by oceans and convert them into Carbonic acid. This acid lowers the pH level of water and makes it more acidic. More acid blocks the growth of corals and shellfish. It is corrosive to the shells and skeletons of many marine creatures (Figure 1.22).

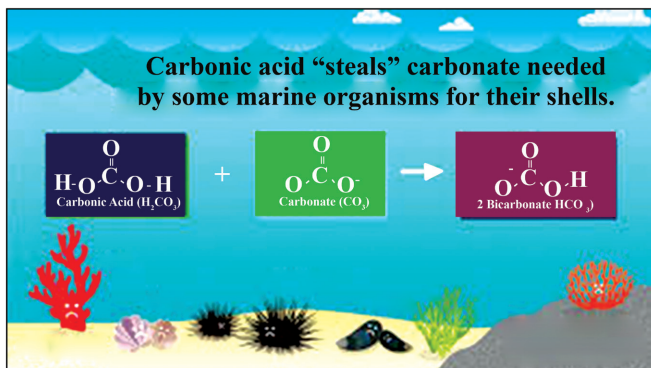


Figure 1.22: Ocean Acidification Affects Marine Organisms, (Source: <http://collagenrestores.com/acid-rain-cycle-diagram-photo/understanding-the-science-of-ocean-and-coastal-acidification-3/>).

Professor Sir Brian Hoskins, Chairman of the Grantham Institute at Imperial College London has said that “Carbon dioxide in the atmosphere is at record levels and so are global temperatures. These are indicators of the big climate problem we are creating for ourselves, and set the tone of great urgency for the negotiators in Paris to make a meaningful agreement that will put us on the road of greenhouse gas emission reductions and elimination that will limit climate change to an amount that we can probably cope with.”

More than 90% of the total heat accumulated in the climate system between 1971 and 2010 has been stored in the oceans. Ocean warming usually happens close to the surface. Since 1969, oceans has been warming at a rate of 0.302°F with the top 700 meters. The Oceans stores and releases heat during regular intervals and this is a natural way by which it stabilizes the climate system. The heat released by ocean turn as winds and rain clouds.

More heat causes a change to this pattern. We know that roughly 70% of the world is covered by oceans and when more hot air covers them, it creates a massive difference in the climate system. When the ocean takes in more heat, they release more heat into the atmosphere. This additional heat causes cyclones and hurricanes. When the air near the surface gets warmer, oceans evaporate more water and this results in more floods and hurricanes.

The average temperatures of the world has increased over the past century. Sea level were considered stable for thousands of years until 19th Century. But the temperature got much warmer for three decades after 1850. Ocean currents have also changed in accordance to the changes caused in surface winds, ocean temperature, and ocean saltiness. The changes include

a southward shift of the Antarctic Circumpolar Current and increasing southward penetration of the East Australian Current.

Even the lives of plants and animals are undergoing shifts in their lifecycles both in land and in oceans. Unless we stop all the human activities that impacts the climate, the temperature levels are going to increase in a steady manner as seen above.

1.4. FUTURE OF EARTH'S CLIMATE AND ITS EFFECTS

The Intergovernmental Panel on Climate Change (IPCC) in its 2013 assessment had given a forecast that the global surface temperature is likely to exceed 1.5°C by the end of 21st century. According to scientists, the temperature of the Earth will be increasing constantly for the next 100 years. Continuous changes in the climate lead to extreme weather conditions. There will be shortage for fresh water, more number of emergencies and deaths occurring from floods, heat waves, droughts and storms (Figure 1.23).



Figure 1.23: Picture depicting projected impact of sea level increase, (Source: https://www.researchgate.net/figure/Future-effects-of-climate-change-on-several-places-of-La-Manga-of-Mar-Menor-according-to_fig11_274179206).

The rising sea level causes floods and scientists even foresee heavy rainfall. Due to floods and rainfall, there will be a possibility for many diseases to spread. The World Health Organization (WHO) has warned the global nations that, health of millions of people will be at risk as there will be an increase in malaria, other water-borne diseases and also people might suffer from malnutrition. Not every country will suffer the same way; the poor countries that are not prepared or rather unable to protect themselves due to financial strains will suffer the most (Figure 1.24).

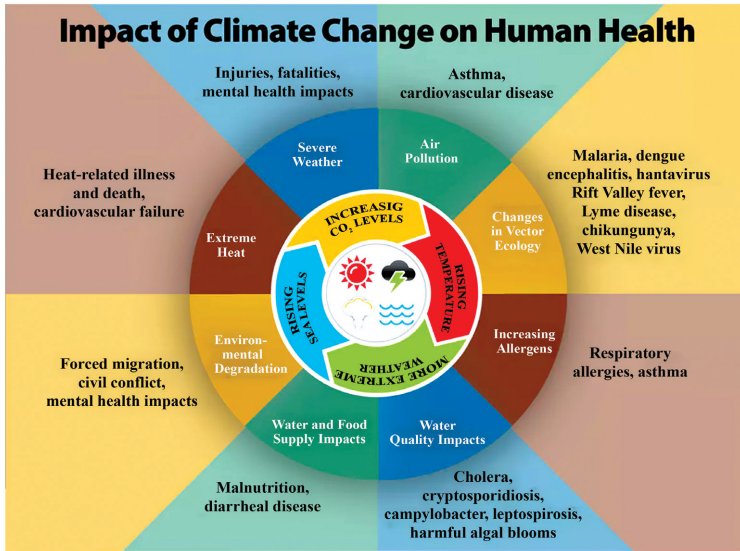


Figure 1.24: Impact of Climate Change on Human Health, (Source: <https://www.cdc.gov/climateandhealth/factsheet.htm>).

As the Oceans absorb more Carbon dioxide, it becomes more acidic and this acidification will become a major problem for the coral reefs as these chemical changes will prevent corals from forming a calcified skeleton which is very much essential for their survival. The Climate change will have different impact in various places across the earth (Figure 1.25). Some places may get more rain but some will get less rain. Some places will have very high temperatures whereas some other places will experience very cold winters with snow.



Figure 1.25: Picture representing future of earth due to climate change, (Source: <http://www.indiacelebrating.com/essay/climate-change-essay/>).

Climate change has already brought about many risks to the humans such as depletion of ozone layer, loss of biodiversity, changes in food processing systems and many others. Climate change affects humans directly as well as indirectly as shown in Figure 1.26.

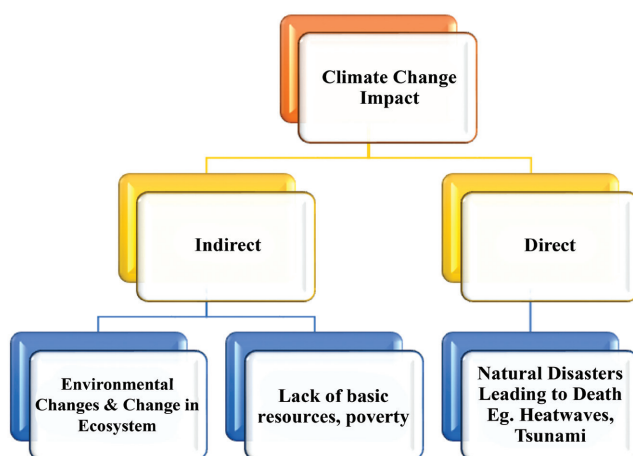


Figure 1.26: Impact of climate change.

Scientists are monitoring even the small change in the Earth's Climate very deeply. The satellites send by NASA constantly reads the temperature of Earth's land, water, air, and ice. There are also other tools that check the temperature and amount of energy coming out from the Sun. Scientists even use climate models to analyze how the climate of the Earth will change in future. 'Climate models' are nothing but computer programs with mathematical equations that are used to accurately retrieve past climate. The Climate models, satellites and all other tools helps Scientists in understanding the change in climate and also predict the future changes to a large extent.

Climate change does not stop with affecting only natural resources but these changes impact tourism industry as well. The U.S. National Park Service collected data on the annual recreation visits by millions of people and the temperature and did analysis on how the climate change will alter the visits. Study was conducted at 340 parks for the period 1979 to 2013. The study revealed that visitation increased with increase in average monthly temperature but decreased when temperatures rose above 25°C. It is predicted that very warm months may have less number of visitors at the parks. Impact of Climate change will always remain a critical challenge for the world economy and especially for U.S. economy as Tourism

industry in U.S. is a fast-growing sector. The United States of America has always attracted many tourists from across the world due to its fabulous destinations and this demand is increasing every year. Although U.S. has advanced technologies, adapting to climate change is something that the U.S. government is still working on. Climate change is seen as one of the challenge for the sustainable development of tourism industry as tourism is more dependant upon climate. Most of the people in U.S. move from one State to another throughout the year for holidays depending on the climate (Figure 1.27).



Figure 1.27: Preserving earth, (Source: <https://www.slideshare.net/dbgksz/co-menius-2010effect-of-climate-change-on-tourism>).

In today's world holidays have become an essential part of life and most of the people go on tours to spend their holidays. This denotes the importance of tourism in today's world. Also, tourism forms a major part of economy in many countries. The tourism industry itself is spending more money and people for its business development. This industry will fall as a prey to climate change if the existing changes continue. We all should remember a fact that only if there is a wall it can be painted; similarly only if the places remains attractable, people will want to see it. Only if we care for mother Earth we can live and admire its beauty, if not, nature will find a solution on its own.

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CHAPTER 2

IMPORTANCE OF CLIMATE IN THE TOURISM INDUSTRY

“The traveler sees what he sees; the tourist sees what he has come to see.”

—G. K. Chesterton

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We know that Tourism is a global industry and there are many factors that make this industry flourish. One such factor that decides the very existence of tourism industry is the prevailing climatic condition. This has been proved from the various studies conducted in this subject. Many surveys conducted among thousands of tourists reveal that, climate remains to be one of the most important factors in deciding the choice of tourist destination. In this Chapter, we will analyze deeply the reasons why tourists give so much importance to climate. In today's world, we are witnessing so many climatic changes and these changes are making a shift in the seasons across many destinations. Due to this many places that were lesser known to the outside world are now becoming tourist destinations. Along with this, we will also study about various destinations that are popular among tourists not only for its beauty but also for its pleasant weather conditions.

2.1. CLIMATE DETERMINES THE CHOICE OF DESTINATIONS

When it comes to holidays, choosing the apt destination becomes a tedious task for most of the families. Although the families or individuals look upon many factors like cost, attractions, accommodation facilities, accessibility, culture, etc., before planning a trip, it is the climate factor that finally decides the destination. A number of studies conducted states that climate is the main factor that determines tourist flow in a particular destination.

Tourists in general compare the climate of their origin to that of the destination. People from colder regions prefer to go to warm countries and in the same way people living in hot countries are very particular in choosing cold countries for spending their holidays. Temperature plays a key role since it has the ability to make the trip a memorable one either in a good way or negative way. In the current scenario, destinations with the desirable temperature include the African highlands, South Australia, the Mediterranean regions and South Africa.

Tourists look for places to relax themselves during the holidays and hence climate of the destination place is very important for them than the local people residing there. All other factors that people think of before deciding on a travel are man-made factors whereas climate is the only natural factor (see Figure 2.1). The turnover of tourists in a particular destination spikes up or drops down depending on the climate. People become very sensitive to climatic conditions especially when they are on a holiday trip. Thus weather becomes an integral part of tourism (Figure 2.1).



Figure 2.1: Factors that influence destination choices, (Source: <http://slideplayer.com/slide/6176264/>).

Although tourists look for various recreational activities that the destination provides, the environment in which these activities are carried out is equally important. Climate comes under the physical environment because an unpleasant weather has the ability to ruin the entire activity. Many activities that were planned by the tourist operators may get cancelled due to bad weather and the point is that we cannot blame anyone other than our poor choice of selection.

Whenever the subject 'tourism' is brought about, the discussion never stops without making a mention on climate. In a study conducted by Hamilton and Tol (2006) across tourists from 45 countries with different climates, it became clear that tourists preferred countries with a sunny, yet mild climate and ultimately everyone preferred the holiday climate to be different from their home climate. In another survey study by Hamilton and Lau, 2004, it was found that tourist, research and learn about the climate of their destination well before they finalize their decisions. A Psychological experiment (Braun et al., 1999) was conducted to understand the tourist behavior towards climate change; the result of the experiment was that climate change influences the preference for choosing vacation destinations. All these studies clearly specify that people change their destination choice depending upon the changing climate.

2.2. CLIMATE CHANGE CREATES NEWER DESTINATIONS

Tourism is a major part of economy in most of the countries. There were 698 million international travelers in the year 2000 and this number increased to 1 billion in 2010 and it is expected that this number may rise to 1.6 billion by 2020. The revenue generated out of tourism is vital for the growth of a country. Apart from revenue, the employment opportunities created by tourism industry is very important especially for the developing nations. According to some estimates, tourism forms 10% of world's economic activity. Climate change is causing a shift in the seasons in many regions. Due to these changes, some areas face more challenges in terms of holding the fame as tourist destinations and some countries get new opportunities to show their beauty to the outside world.

Millions of tourists from all over the world are mainly attracted towards the snow-capped mountains, tropical vegetations, misty forests, sparkling glaciers and sandy beaches. These tourists bring in so much revenue to the destination location. All these are going to change. Climate change will remove all the likeliness factors that attract a person towards a destination and it will drastically reduce the number of visitors. Also the change in weather patterns will permanently remove some of the favorite destinations from tourists' mind. The Changing climate is a great threat to the economy of the nations; but on the other hand, some other countries are going to reap the benefits. Some countries are going to emerge as winners in the tourism industry and some to become losers.

The climate change is already causing shorter winters and long summers. Because of this, the demand for winter sports is diminishing. Winter temperatures are increasing at a rate of 1° to 3°C with most of the warming happening at higher elevations. For example, the Alps Mountains are warming at almost three times the global average. A study made on the snow cover in the Alps concluded that each increase of 1°C corresponds to a 150 m move up the mountain of the line marking the lower limit of adequate snow for ski resorts which means every degree of warming will end up with a further decline in the snow making it almost impossible for the ski operators to continue their business (Figure 2.2).



Figure 2.2: A warning board indicating no skiing, (Source: <https://www.cb-snews.com/news/warmer-winters-threaten-the-bottom-line-for-ski-resorts/>).

Since the snow is reducing in high altitude mountains, places that have not been much impacted will have a greater demand. Resorts in those places will have to plan to accommodate more tourists. The change in climate has some positive as well as negative effects on the tourist destinations. For example, if we consider Arctic region, these regions are very popular for its winter seasons and the seasonal flora and fauna which attracts many visitors. Due to the climatic change, the Arctic regions may experience long summers and this will not have much impact on the tourism as people would like to make use of summer season by taking a cruise ride and involving in activities such as whale-watching.

Unlike any other environmental change, climate change is not something that can be fixed immediately. Climate change will change the fate of many holiday attractions and there will be a shift both in the domestic and international tourist flow. Many analyses done by various groups' states that tourism sector will improve in the Northern regions although North have been the highest contributor for Carbon emissions which has led to climate change and the tourism industries in the Southern regions is going to suffer in spite of being a less Carbon contributor.

In order to have a better assessment, Deutsche Bank Research compared most of the countries which are making high in the tourism sector with the help of a scoring model. The model in which the research was carried out was based on the following four parameters:

- Direct Climatic Effects;
- Substitution effects resulting from Climate;

- Regulatory burdens and consequent geographical substitution effects; and
- The possibility of each country having to adapt to climate effects.

These parameters were carefully assessed for all countries and they derived at the result as shown in the Figure 2.3.

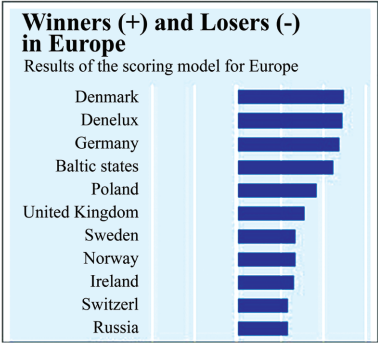


Figure 2.3: Winners and losers in Europe, (Source: <https://yaleglobal.yale.edu/content/climate-change-and-tourisms-winners-and-losers>).

From the study it is clear that in Europe, countries bordering the Mediterranean in specific, will suffer from climate change. The rise in temperatures and water shortages caused due to climate change is the main reason for low turnover of tourists. It seems that Canada, New Zealand and USA are the only countries outside of Europe where tourism will not be affected by climate change. The tourism sector of Latin America, Africa and Asia will have some negative implications in the coming decades as the climate varies.

Some countries such as Kenya, Caribbean and Tanzania have high hopes on tourism for their development but it is likely that the climate change is going to burden them more. The island nations and the coastal areas are to be affected the most by climate change and that is the main reason why tourism will decline in those countries. The Bahamas and Jamaica in the Caribbean, Thailand and Malaysia in Asia and Tunisia and Morocco in Africa will all face the impact due to the same reason. Not to miss the island states in the South Pacific and the Indian Ocean.

Many destinations have unique peak seasons and the climate change is causing a shift in the peak seasons of some of the destinations. Already the tourists visiting Spain, Sydney and Melbourne are very much concerned about the intensity of the heat waves during the holiday times. Tourists will

prefer going to beaches or mountain environments; but the mountains will struggle to maintain viable ski tourism. Research taken over snow depths in Australian ski resorts shows that by 2040 and 2090 there will be significant reductions, and snowmaking will not be able to compensate for this loss if temperatures are too warm (Figure 2.4).



Figure 2.4: Artificial snowmaking machine, (Source: <https://unofficialnetworks.com/2015/10/22/snowmaking-works-unofficial-explanation/>).

Although Climate change has such a negative side to it, the only point to relax is the emergence of new travel destinations. A Government report on Climate change has found that Britain is going to become a holiday hotspot in another forty years or so because of the warmer weather. A report released by the Department for Environment, Food and Rural Affairs has mentioned that tourists from Southern Europe may visit UK to escape increased heat in their country and the British tourists will prefer to remain in their home country rather than travelling to France or Spain. The report further stated that, “Hotter summers and warmer year-round temperatures may make UK more attractive for foreign and domestic holiday makers. In particular, Britain could be well placed to attract visitors deterred by the uncomfortably high temperatures in Southern Europe projected to result from climate change.”

Since the climate has become uncertain, people have started choosing destinations depending upon the climatic condition in specific months. Tourists are also showing interest in travelling to newer destinations.

2.3. TOURIST DESTINATIONS WIDELY POPULAR FOR ITS WEATHER

Tourism business has been in existence from a very long period. People choose certain destinations particularly to enjoy its weather. Be it the warm and sunny beaches or snow clad mountains, people enjoy when the climate is perfect for their holiday. But finding a place with the perfect climate is not an easy task. And in particular, the definition of a perfect climate means different temperatures to different persons. Some may prefer hot climate whereas some prefer cooler climate. Ideally a best climate should be the one that suits anyone's body all over the year and they need not make any adjustments. A best climate must not be too hot or too wet or too cold. Also it is very rare to find a destination that has a stable and pleasant climate all year long. In particular, there should not be any extreme weather events such as floods, hurricanes, etc.,

It is not guaranteed that all the popular tourist destinations may always have a pleasing weather. But the places with the apt climate will surely be a tourist destination and also with a high population since climate is of that importance to everyone. Moreover, almost all these places will be near sea or ocean. This is due to the fact that the weather in the areas nearer to seas and oceans are usually mild and most bearable.

In this section, we will look at some of the destinations that are popular among tourists for their beautiful weather:

2.3.1. Vina del Mar, Chile



Figure 2.5: Tourist hang out at the beach in Vina del Mar, (Source: <http://dawn-andjon.blogspot.com/2013/03/chile-vina-del-mar.html>).

Vina del Mar ranks among the top in list because of its temperature range. The temperature here rarely goes above 30°C while the average minimum temperatures even during peak winter times will drop only till 11°C and not less than that. The average rain measures upto 19 inches each year and most of the rain can be seen only during winter. The temperature here ensures that the tourists will have a wonderful and relaxing holiday trip (Figure 2.5).

2.3.2. Adelaide, South Australia



Figure 2.6: A beautiful morning in Adelaide, South Australia, (Source: <http://www.traveller.com.au/the-worlds-greatest-climates-top-cities-to-visit-for-perfect-weather-all-year-round-gshzcu>).

For people who have experienced hot burning weather in South Australia, this place would seem like a heaven. Rainfall is relatively low here and this is one of the best places for tourists as compared to other places in Australia (Figure 2.6).

2.3.3. San Diego, California

The location of San Diego near the coastal region brings cool breeze all the time. Due to the cold streams, even the summers are good with not much heat. It is the southern most of all the South Pacific U.S. cities (Figure 2.7).



Figure 2.7: The beautiful San Diego, California, (Source: <https://www.family-vacationcritic.com/best-luxury-hotels-in-san-diego-for-families/art/>).

San Diego's latitudinal position is above the Tropic of Cancer and this gives it a warm temperature. The Rocky Mountains and the Pacific Ocean gives it a great climate. The desert behind it proves that rainfall is very less in this region. Many rich Americans live in San Diego because of its pleasant climate.

2.3.4. Las Palmas, Spain



Figure 2.8: Lovely Las Palmas in Spain, (Source: <https://d1bvpoagx8hqbg.cloudfront.net/originals/experiencia-las-palmas-gran-canaria-espana-por-cristina-31626ea5384f8768875d9d0bc1d29689.jpg>).

Las Palmas, the Capital of Gran Canaria also came on top in the list of destinations with ideal climate. Thomas Whitmore, the Director of Research on Climatology at Syracuse University conducted an experiment in 1996, wherein he studied the climate of 600 cities across the world for his "Pleasant Weather Ratings" and Las Palmas got a three-star rating all the year

round. According to the Handy Website Holiday Weather, the average temperature in Las Palmas is between 18–25°C but it still receives an average rainfall of 11 days during December (Figure 2.8).

2.3.5. Yuma, Arizona



Figure 2.9: Balloon festival in Yuma, Arizona, (Source: <http://www.traveller.com.au/the-worlds-greatest-climates-top-cities-to-visit-for-perfect-weather-all-year-round-gshzcu>).

According to some data facts provided by weather stations to the World Meteorological Organization, Yuma in Arizona comes in top as a place that has good weather. This is the place where the Arizona, California and Mexico borders meets and it gets an average sunshine of 4,015 hours a year which is equivalent to 11 hours per day. There are also other places in Arizona which has a great weather but those places still remain remote and without habitation (Figure 2.9).

2.3.6. Mombasa, Kenya



Figure 2.10: A beach in Mombasa, Kenya, (Source: <http://sheheena.com/news-event/>).

Mombasa is the second largest city in Kenya and is located near the equator. The climate throughout the year is around 25–30°C. The clouds that covers most of the time is an indication that you are at a place very near to the equator and you can anticipate less rain anytime. Light clouds make the weather cooler throughout the year. The climatic condition is Mombasa is well suited for tourism and recreational activities (Figure 2.10).

2.3.7. Costa Rica



Figure 2.11: Colorful Costa Rica, (Source: <https://womentravelblog.com/destinations/central-south-america/costa-rica-tour-for-women/>).

Costa Rica is well known for its warm sub-equatorial climate with temperature in the range of 24–26°C. Many people buy properties in Costa Rica only for its special tropical temperatures as they are very comfortable with not much hot or cold. The rainfalls are normally short but the climate is always humid (Figure 2.11).

2.3.8. Galapagos Islands

Galapagos Island is located among the waters of the Pacific Ocean. Its perfect location around the equator gives the island a magnificent equatorial climate. The weather is relatively dry here. The first six months of the year is usually warm and slightly moist with temperatures ranging from 21–28°C. As there are no extreme temperatures, tourists find the climate very easy to adapt to. Particularly, there are no hurricanes and the Pacific waters have very moderate temperatures. This amazing climate is the reason behind the existence of exceptional animal and plant world in the Galapagos Islands (Figure 2.12).



Figure 2.12: A sea turtle in the Galapagos Island, (Source: <https://www.ad-gentes.ch/hotel/red-mangrove-galapagos-lodges/bh/typo3>).

2.3.9. Hawaii Islands



Figure 2.13: A historic landmark in Hawaiian Island, (Source: <http://www.hawaiiigaga.com/best-hawaiian-island.aspx>).

Hawaii is known as the warmest American state but with no high summer temperatures. The Temperatures range from 26–30°C throughout the year. We cannot witness any climatic events like rainy season, hurricane, etc., Similar to Canary Islands, the dust level is very low. This island is located in the heart of the Pacific Ocean and that is the reason why Hawaii is among the best tourist destinations in the world (Figure 2.13).

2.3.10. The Canary Islands

The Canary Island is located near the shores of Africa but it is a Spanish territory. The climate in the Canary Island is even hard to imagine. The cold Canary stream that passes over the islands makes the climate to be cool as the ocean temperature is in the range 19–25 degrees throughout the year. Due to the flowing Canary stream, the temperature does not become too high or too low (Figure 2.14).



Figure 2.14: A view of the Canary Island, (Source: <https://tgigolftravel.com/destinations/canary-islands>).

Summer temperatures are about 26°C and the winter temperature is about 21°C. There is no fear for hurricanes because hurricanes are usually formed in warm ocean waters but the seawater is moderate here. The weather is normally dry and the probability of a rainy weather is very less. Above all, the Canary Island is one among the places that has the cleanest air and low dust on this planet.

2.3.11. Bermuda Islands

Bermuda islands are located in the subtropics but still it does not have very hot tropical climate. It is because the warm Gulf Stream carries warm water all the way to Europe. The ocean acts as a natural air conditioner and maintains a very pleasant climate. Temperatures here range from 21°C in January to 30°C in August. Certainly Bermuda Island is one of the places in the world with best climate (Figure 2.15).



Figure 2.15: Bermuda Islands, (Source: <https://www.blacktomato.com/us/inspirations/whats-on-in-bermuda/>).

2.3.12. Mexico City



Figure 2.16: The Mexico City, (Source: <https://www.beachacationsand-more.com/mexico-vacation.html>).

This city has a cool tropical mountain climate; thanks to the high altitude that rescues the city from the unbearable typical tropical heat. The average temperature ranges from 21–27°C with rainy weather during the summer months. May is the warmest month and December remaining to be the coldest. Mexico City is highly populated and it is clearly understood that the mild climate is the reason behind it (Figure 2.16).

2.3.13. Costa del Sol



Figure 2.17: Costa del Sol beaches, (Source: <http://blog.fuertehoteles.com/en/top-ten/best-beaches-costa-del-sol/>).

This South Coast of Spain is a popular winter spot for millions of Europeans and also other tourists coming from colder countries. Mediterranean Sea brings in a pleasant climate in Costa del Sol throughout the year. Winters are quite short here i.e., for two to three months with day temperatures not exceeding 17–18°C. Summers are pretty warm with temperatures around 29°C. Here sun is quite visible throughout the year (Figure 2.17).

2.3.14. Sao Paulo



Figure 2.18: Sao Paulo, (Source: <https://www.skyjetairtravel.co.uk/brazil/cheap-flights-to-sao-paulo-from-london/>).

Sao Paulo is Brazil's largest city and is located in the tropics of South America. Although the city is located on a high plateau it is very much near to the ocean shore. Sao Paulo and Rio de Janeiro are almost situated in the same latitudes but when compared to Rio de Janeiro, Sao Paulo has a much cooler and light climate. The temperature varies between 22–27°C throughout the year. Similar to Mexico City, Sao Paulo attracts large population with its mild climate (Figure 2.18).

2.3.15. Swakopmund in Namibia



Figure 2.19: Swakopmund, Namibia, (Source: <http://hikersbay.com/africa/namibia/swakopmund?lang=en>).

Swakopmund is a Germanic resort town which receives just over half an inch of rain every year. With regards to heat, there is a consistent six to seven hours of sunshine every day. The Climate here is so mild that the average minimum temperatures are between 10 to 16°C while the average maximum temperature is within 18 to 23°C (Figure 2.19).

Many other destinations with more suitable climate include Lisbon, Barcelona, Ecuador, Malaga in Spain, New Zealand's North Island, Medellin in Colombia, the North-West Moroccan coast, Cyprus, Madeira and Port Elizabeth in South Africa.

A perfect weather is so crucial in deciding upon a destination for vacation. Any extreme climatic events may ruin the mood of the entire trip. Planning to go to a place with the right temperature may be a difficult task for many especially when considering the distance, cost and also when travel to multiple destinations are planned. More time will be spent only on doing research about the places and their climate. Instead it will be easy if we

know what will be the best time of the year to visit a particular place and the prevailing climatic condition during that period. If we have this information handy, then we can plan accordingly and visit any number of places during the right season and also have fun. Let us now look into Continent as well as Country-wise places and get to know more about the best time to visit these places:

2.3.16. Africa

The Tourism Industry of Africa promotes their nation by showcasing its rich dense forests and giant animals. People would naturally get attracted and would love to visit Africa at least once in their lifetime. Africa is considered to be the hottest continent in the world and since it is a tropical region, it never freezes except for the Great Rift Valley. The spring season in Africa is from September to November and the autumn season starts from March and it remains till May. For tourists who are considering a trip to Africa, March, April, September or October are the best months since the weather is not too hot.

We shall look into some of the top travel destinations in Africa and the best time to reach there:

Kenya (Figure 2.20).



Figure 2.20: Jungle safari in Kenya, (Source: <http://www.holidaytours.one/event/kenya-jungle-safari-2/>).

Kenya has abundant range of wild animals and this is what makes it attractive because of the wildlife safaris where we can watch the movement of numerous wild animals. Kenya is located in the East of Africa and it is surrounded by the Great Rift Valley, Savanna and the Lakelands. The best time to visit Kenya is the dry season as there will be clearer skies with Sun and less hope for rains. So the tourists can plan for a trip from June to October as this is the dry season and more importantly there will be fewer mosquitoes during this period.

2.3.16.1. Morocco



Figure 2.21: Cloudy blue town in northern Morocco, (Source: <https://www.dreamstime.com/stock-photo-old-town-chefchaouen-morocco-blue-architecture-buildings-alley-small-berber-northern-famous-s-houses-popular-image66897109>).

Morocco is a beautiful North African Country and spring season makes it look more beautiful (Figure 2.21). Spring season in Morocco is from mid-March to May and visitors during this period will be able to view the lush green landscapes. Morocco is a blend of Berber, European and Arabian culture and it has got some famous attractions like Mauresque buildings of Casablanca, art galleries of Queda, Marrakesh's walled medina, Ouarzazate's deserts, film studios and much more. Tourists can also try visiting Morocco during Autumn, i.e., from September to October since the temperature will be more pleasant during this time.

2.3.16.2. Zimbabwe



Figure 2.22: Victoria falls, (Source: <http://scopeintervention.blogspot.com/>).

Zimbabwe provides plentiful options to its visitors. Zimbabwe is situated in the Southern part of Africa and it is well-known among tourist for its wildlife, parks, safaris and especially Victoria Falls on Zambezi River which is a favorite spot for white-water rafting and bungee jumping (Figure 2.22). Victoria Falls is at its best during April and May after the end of summer rainfall, when the river is flood-full. People can directly avoid visiting Zimbabwe during September and October since the climate is extremely hot and dry during this period but if someone is fond of rafting then the period between August to December is the ideal time for them as the water level will be low. The best time to visit Zimbabwe is from May to October as it is the dry winter season with mild temperature, no rain and less risk of catching malaria.

2.3.16.3. Tanzania

Tanzania which is located in the east of Africa is the home for many beautiful parks such as Kilimanjaro National Park, Serengeti National park, Mafia Marine Park and also some of Africa's highest mountains. Tanzania is famous for its Safari Mecca which is populated by an elephant, lion, leopard, rhino and buffalo. No other period other than the dry season that runs from June to October would be the best to visit Tanzania (Figure 2.23).



Figure 2.23: Northern Tanzania safari, (Source: <https://www.scottdunn.com/luxury-tours/classic-northern-tanzania-safari-and-zanzibar>).

2.3.16.4. South Africa

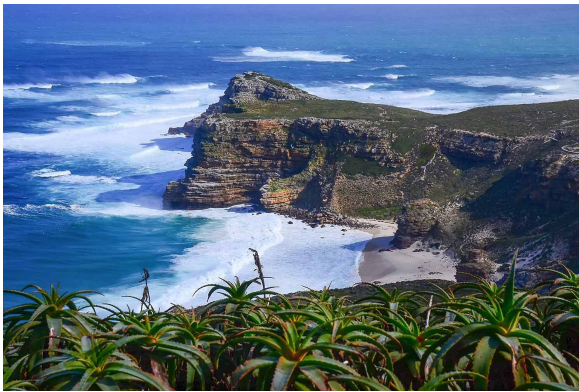


Figure 2.24: Cape of good hope, South Africa, (Source: <https://vivitravels.com/en/discover-south-africa/tour-with-cape-town-and-garden-route-south-africa>).

South Africa is popular for its wild safaris, beaches, lagoons, dense forests and Cape of Good Hope's craggy cliffs. Kruger National Park is also located in South Africa. The best period to go on a safari is dry winters that run from May to October but, if the intention is to enjoy the beach then the ideal period is the hot summer season between November and March.

2.3.17. Asia

Asia, the largest of all the continents has diverse countries with diversified climate. Most of the tourist places in Asia lie in East Asia, Southeast Asia and Southern Asia. Let us look at each region one by one:

2.3.17.1. East Asia

East Asia has a normal temperate climate where the summers are warm and winters are cold. We can find rainfall during summer. Some of the top destinations in East Asia are listed below along with their climate information.

2.3.17.1.1. Beijing



Figure 2.25: Snow covered great wall of China, Beijing, (Source: <https://livingnomads.com/2017/12/best-christmas-towns-in-the-world/beijing-winter-great-wall-2/>).

The Capital city of China has some great attractions like the Imperial Palace, Forbidden City complex, some sections of Great Wall of China and many more. Beijing has a perfect weather during the months of April, May, September, and October and the city can be best visited during this time (Figure 2.25).

2.3.17.1.2. Tokyo



Figure 2.26: Tokyo glittering at night, (Source: <https://www.tsunagujapan.com/a-guide-to-tokyos-climate-throughout-the-year/>).

Tokyo is the capital of Japan and the city always glitters with streets filled with so many shops, huge buildings, temples that are an architectural wonder and neon-lit skyscrapers. Autumn is the best time to visit Tokyo as the already sparkling streets becomes more colorful during this time. September to November is the autumn season and the temperature will be pretty good that time (Figure 2.26).

2.3.17.1.3. Hong Kong



Figure 2.27: Hong Kong, (Source: <https://www.bookmundi.com/hong-kong/travel-guide/best-time-to-visit-hong-kong-418>).

Hong Kong is famous for its high towered skyline, historical monuments and amusement parks. This vibrant and densely populated city is located in Southern China. Hong Kong should be visited during the period October to early December as the weather is both cold and sunny at the same time and makes it very pleasant for the tourists to hang around (Figure 2.27).

2.3.17.1.4. *Seoul*



Figure 2.28: Seoul, (Source: <https://www.garuda-indonesia.com/sg/en/discover/destination/seoul.page?#>).

Seoul is a metropolis city in South Korea and the city is filled with skyscrapers and Buddhist temples. We can also see mixed pop culture here and there are many popular attractions like the Dongdaemun Design Plaza, the convention hall, Gyeongbokgung Palace and Rooftop Park. The weather is mild from March to May and from September to November and so it is the ideal period to visit Seoul (Figure 2.28).

2.3.17.2. *Southeast Asia*

Southeast Asia also lies near the tropical region and so the weather in general is hot and humid. Monsoon starts from June and continues till October in Southeast Asia. Let us look into some of the top destinations in Southeast Asia and get to know their weather details

2.3.17.2.1. *Singapore*

Singapore is a small beautiful island city and some of the popular tourist spots are Chinatown, Arab Street and Little India. There is so much to see in Singapore especially the different street fairs they organize. A trip to Singapore can be taken any time of the year, as the climate is almost the same throughout the year. Avoid travelling during Chinese New Year just to avoid crowds (Figure 2.29).



Figure 2.29: Singapore Glittering at Night, (Source: <https://www.venzuoverseas.com/study-abroad/singapore/>)

2.3.17.2.2. Malaysia



Figure 2.30: Kuala Lumpur, Malaysia, (Source: <https://www.pinterest.com/pin/356347389242502202/>).

Malaysia stands as per its tag line ‘Truly Asia’ since we can see the influence of many Asian regions here. Malaysia is best known for its beaches, rainforests, shopping places and colonial buildings. Tourists can plan to visit Malaysia from March to early October, since there will be very little rainfall and less humidity during this period (Figure 2.30).

2.3.17.2.3. Bangkok



Figure 2.31: Bangkok, Thailand, (Source: <http://beautynamazingworld.blogspot.com/>).

Bangkok, the Capital city of Thailand is well-known for its lively street life and legendary monuments. The temperature starting from October to March is not too hot or humid and so it is the best time to visit Bangkok. But sometimes the temperature can rise to 90°F (Figure 2.31).

2.3.17.3. Southern Asia

The weather of Southern Asia can be split as summer, winter and monsoon. Some of the top tourist destinations in Southern Asia along with the weather patterns are given below:

2.3.17.3.1. Katmandu



Figure 2.32: Katmandu in Nepal, (Source: <https://www.himalayanmentor.com/kathmandu-valley-tour.html>).

Katmandu is the capital city of Nepal and it has got so many museums and national parks for the visitors to see. The ideal time to travel to Katmandu is the autumn season which falls between September and November. In Katmandu, the weather during the autumn season is so pleasant (Figure 2.32).

2.3.17.3.2. *India*



Figure 2.33: A hill station in India, (Source: <http://www.stunningalways.com/5-most-beautiful-hill-stations-india-world/>).

India does justice to its tourism tagline ‘Incredible India.’ There are so many natural as well as artificial wonders in India that travelers cannot get enough of it. Every state in India has its own beauty and uniqueness and the climate enhances the beauty of it and makes it so memorable in the hearts of the travelers. The best period to visit India is from October to February, when the weather is very pleasant with very little rainfall overall (Figure 2.33).

2.3.17.3.3. *Maldives*



Figure 2.34: Maldives, (Source: <https://www.sensationsdumonde.com/guide-voyage/maldives/avant-de-partir>).

Maldives is always a tourist treat and it is considered to be the paradise on Earth. Maldives offers everything that the tourists desire. The ideal time to visit Maldives is between December and April since there won't be any rainfall during this period (Figure 2.34).

2.3.17.3.4. *Mauritius*



Figure 2.35: Mesmerizing Mauritius, (Source: <https://www.flamingotravels.co.in/international-tours/international-individual/mauritius/all-inclusive-mauritius17.html>).

What can be compared to the stunning beauty of Mauritius? It's a heaven on Earth for the tourists. Starting from May to December, the climate is cold, dry and as well as sunny and this is the best time to stroll around Mauritius.

2.3.17.3.5. *Sri Lanka*



Figure 2.36: Hill country, Sri Lanka, (Source: <http://ceylontouradvisor.com/index.php?nav=tour&tour=11>).

Sri Lanka is a beautiful island nation with a rich cultural heritage. It is best for the adventurers to visit Sri Lanka during dry season. But the dry season varies among places inside Sri Lanka. In the North and East Coast of Sri Lanka, dry season starts from May to September and in Kandy and Hill Country, the dry season is between December and March (Figure 2.36).

2.3.17.3.6. Madagascar



Figure 2.37: Andilana beach, Madagascar, (Source: <https://www.legrandbleu-nosybe.com/it/andilana-baie-plage-hauts>).

The fourth largest island on this Earth is the Madagascar Islands and it always looks colorful with nature at its best. Tourists can visit Madagascar in the months of July and August since it's the winter season and the weather is cold during that time (Figure 2.37).

2.3.18. United States of America

There is a mixed weather across all the states of USA. The South-West United States is very hot and dry during summer season. Southern Florida and California face endless summers. Southern regions experience mild winters. But the winters are very cold with sub-freezing temperatures and heavy snowfall in the north, plain states, Northeast and in the Western mountains. Hence spring season is the best period to tour USA. Let us see some of the famous attractions in USA and learn about the best time to visit those places:

2.3.18.1. Los Angeles



Figure 2.38: Disneyland, Los Angeles, (Source: <https://www.travelonline.com/usa/los-angeles/attractions/disneyland.html>).

Los Angeles is famous for its iconic Hollywood sign and Disneyland which is the eight themed amusement park. Months from March to May or September to November are the best period to visit Los Angeles since there will be fewer crowds and clean air (Figure 2.38).

2.3.18.2. Orlando



Figure 2.39: Church Street in Orlando, (Source: <http://www.orlando.com/attractions/church-street.htm>).

Orlando is located in Central Florida and it serves as a perfect holiday destination for families because of the large number of amusement parks,

the most popular one being the Walt Disney World. The weather is very pleasant between January and April and hence it is the best time to visit Orlando as a family (Figure 2.39).

2.3.18.3. Las Vegas



Figure 2.40: Las Vegas, (Source: https://wikitravel.org/en/Las_Vegas).

Las Vegas can be visited during the months of March to May and September to November. These two periods are considered perfect since the weather is warm but not too hot, since overheating is definitely a problem when tourists walk around the numerous casinos and resorts (Figure 2.40).

2.3.18.4. New York City



Figure 2.41: New York City, (Source: <https://santorinidave.com/best-time-to-visit-nyc>).

People from all around the world love to go to New York City because of its great iconic tourist attractions and the weather helps in satisfying the desire of its visitors as New York can be visited anytime of the year since the weather of New York City is always pleasant (Figure 2.41).

2.3.19. Europe

The continent of Europe is a tourist's paradise. Europe in total has 45 countries and hence there is a wide range of climate variations. All the North European territories are quite cold with sufficient snowfall from December to March and all the Southern countries are almost hot the whole year with rainfall during winter. The tourism package costs are generally less in May, June and September, owing to the low turnover and hence those are the best months to visit Europe. Some popular destinations in Europe are listed below with details about the perfect time to visit them.

2.3.19.1. London



Figure 2.42: London, (Source: <https://steemkr.com/romantic/@acilsyahrin/11-most-romantic-places-in-world-for-vacations>).

London, a magnificent and beautiful city is located on the Thames River. This Capital city of England has many historic tourist attractions. Spring and autumn are the best seasons to tour London and these seasons' falls during March to May (Figure 2.42).

2.3.19.2. *Paris*



Figure 2.43: Paris, France, (Source: <https://viajesfull.com/viajes-a-europa/viajes-a-francia/paris-en-invierno/>).

Paris which is the Capital of France is also a global center for Fashion, Art, Sculpture and many other things. This is one of the most populated tourist destinations in the world and the best months to visit Paris is July and August (Figure 2.43).

2.3.19.3. *Barcelona*



Figure 2.44: Barcelona, Spain, (Source: <https://in.pinterest.com/mikaelobar-nacit/my-city-barcelona/>).

Barcelona in Spain is known for its peculiar architecture and vibrant street life and food. Barcelona can be visited between May and June as the weather during this short spring period is pleasant and tourists can normally witness various festivals and carnavalesque, if they visit during these months (Figure 2.44).

2.3.19.4. Rome



Figure 2.45: Most Beautiful City – Rome, (Source: <https://steemit.com/life/@mmouaz/most-beautifull-cities-of-world>).

Rome is such a beautiful city and it is the Capital of Italy. People love to visit Rome to enjoy sight-seeing and to eat at outdoor cafes. Hence Summer time is the best time to visit Rome. Months' starting from June to August is the summer time in Rome and the temperature is very mild with very less rainfall.

The Climatic conditions are carefully analyzed for each place before tourists decides upon the place of travel and period of travel. This shows the importance of Climate in the tourism industry.

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CHAPTER 3

IMPACT OF CLIMATE CHANGE

“I’ve starred in a lot of science fiction movies and, let me tell you something, climate change is not science fiction. This is a battle in the real world; it is impacting us right now.”

—Arnold Schwarzenegger

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A small change in Climate has a great impact on the Earth. Climate change causes a shift in everything. Right from sea and oceans to land and atmosphere, everything gets affected. Including humans all species in this world suffer from the consequences of climate change. Many scientists are working hard to find out the impact of each change in order to take the necessary precautions. Most of the times, we remain ignorant of the after-effects of the change in temperatures. This chapter focuses extensively on the impact of Climate change on our planet Earth. We will analyze in depth about the expected and unexpected changes and how the world is going to suffer and transform due to the various alterations in the climatic behavior.

3.1. INTRODUCTION

Climate change and the impact of it is definitely a nightmare for everyone living in this planet. The most feared events have already started to occur; though it has not caused much damage as of now, it is anticipated that the worst is yet to come. The Climate change has been observed in many parts of the world. Climate change is a global issue as the entire environment and every species are affected by it; but all parts of the Earth will not face the same impact. Although many countries will undergo harsh climatic treatments, some countries might get benefited out of climate change. The regions that are already preparing to adapt to the changes would be able to cope with the changes.

According to Intergovernmental Panel on Climate Change (IPCC), the impact of climate change effect on each region will differ over time and with the ability of different societal and environmental systems to mitigate or adapt to change. For example, rise in temperature is one of the climate changes and humans also contribute to this change. As warming is induced by humans, the rise in temperature will not be the same across all countries. Since this is a change which is imposed upon nature by humans it will vary in different places.

The effect of climate change is already spreading and this is going to continue for generations. The result of irresponsible behavior of humans is being felt in the environment and ecosystems. Global warming, increase in sea level, melting of ice in Polar Regions, extreme weathers, heavy rainfall, natural disasters like flood, hurricanes, etc., are some of the impacts of climate change. These impacts will adversely affect the basic human needs such as water, food, health and shelter. There will be too many variations in climate which people may find hard to cope with. Especially older people,

children, pregnant ladies and people of poorer sections will get severely affected due to extreme climate changes. Some places will get very dry; some may get cooler and some with very long summers. Summers can be too hot and it has already taken many people's lives. Hot temperatures are the reasons for hurricanes to occur.

Taken as a whole, the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time.—IPCC

The predictions made by scientists are becoming true today. The Polar Regions are already experiencing the greatest impact of rising temperatures as the snow and ice are melting. The sea level has risen 10–20 centimeters globally over the past hundred years and if this trend continues, the world has to witness severe floods and storm. Some of the low-lying islands and coastal regions have already started to submerge in water (Figure 3.1).

Potential Effects of Climate Change

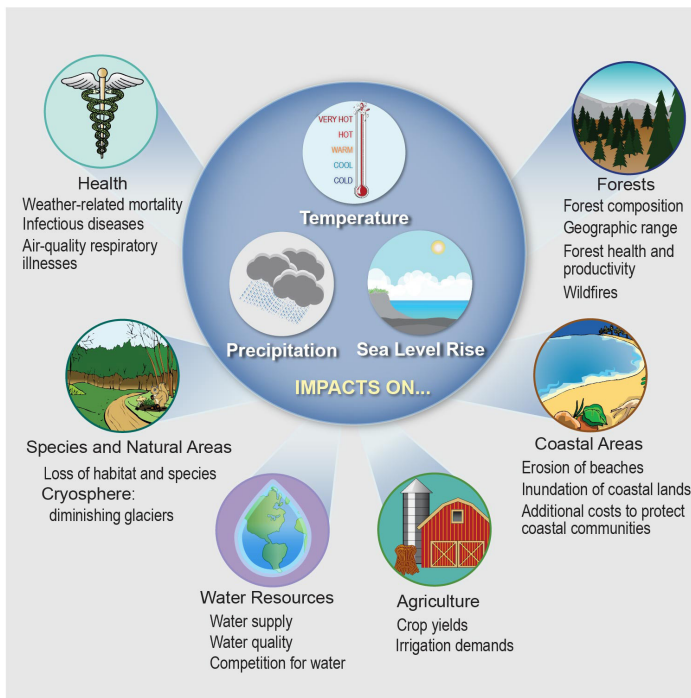


Figure 3.1: Potential effects of climate change, (Source: <https://nca2014.globalchange.gov/report/appendices/faqs/graphics/potential-effects-climate-change>).

All these effects of climate change will ultimately lead to scarcity of basic resources. Due to melting of polar ice and mountain glaciers, there will be a decline in the freshwater resources. People will start wandering in search of food and drinking water. Changes in the pattern and periodicity of rainfall will also be a reason for the difficulty in getting good water. As the available resources will not meet the demands, conflict will arise between nations in acquiring more food. There will be an increase in the migration population due to climate change and security of nations will be at high risk. The leaders and governments of different nations will be forced to help the poor refugees as well as safeguard their own nations from internal issues and international conflicts. These chaos situations were predicted by leaders in the U.S. military back in the year 2007 itself (Figure 3.2).



Figure 3.2: Displaced Iraqis receiving food at a refugee Camp, (Source: https://www.washingtonpost.com/news/monkey-cage/wp/2016/11/23/food-scarcity-causes-conflicts-but-so-does-food-abundance-heres-why/?utm_term=.0a01e501c412).

The United States, the most powerful country in the world has reported that, ‘the Climate change will affect the ability of the Defense Department to defend their nation and poses risk to U.S. National Security. The countries where there is huge population will get severely affected as the agricultural produce will decline. Countries like Asia and Sub-Saharan Africa will come under this category. Climate change will also have its impact on the infrastructure and so re-location or the movement of people will be very difficult.

Another key issue that may arise due to climate change is that the melting of ice cover in the Arctic regions will give more access to the waters. There

is a limited shipping activity carried out in the Arctic Ocean. If the ice melts and when the oceans become freely accessible, a lot of issues will start arising. Many nations will start taking control of the Arctic regions thereby causing environmental problems along with safety and security issues.

Climate change also causes health issues among all species. Many countries will have slow down in their economy. We can see that some birds and animals have already migrated to different places. Heat waves are of great harm to humans as well as animals, birds and other creatures. We are going to learn very specifically about each and every effect of climate change in all possible areas in the below sections.

3.2. CLIMATE CHANGE IMPACT ON BASIC RESOURCES AND THE ENVIRONMENT

Knowingly or unknowingly, we, as humans have done great injustice to Mother Nature and as a result of it, we have started to face its consequences. We never realized the abundance of nature or gave any importance to it and so we have started to suffer from its shortage. Due to various activities carried out by the humans and by other means for the past 150 years, our Planet Earth has lost its balance due to various climate changes and this generation is seeing the impact of it. According to the law of nature, it is the basic resources and the environment that gets affected first due to changes in the climatic conditions.

In this section, we will get to know more about the impact of climate change on the different aspects of environment and the much needed resources for survival.

3.2.1. Impact on Water Resource

Water is the base for living. It is only from the rivers and lakes drinking water is available for humans and animals. Water is very much needed for agriculture and industries. Literally nothing in this world can ever exist without water (Figure 3.3).

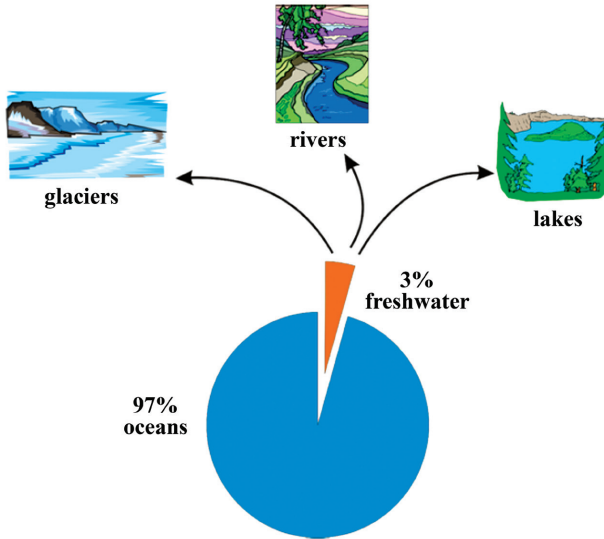


Figure 3.3: Water surrounding the earth, (Source: <http://www.english-online.at/geography/water/water-cycle-treatment.htm>).

There is enough damage caused to the water resources in the past through building of drainage, dredging, silting, pollution, etc., and now climate change is making this situation even worse. The water systems in the world are facing severe consequences due to more flooding and droughts caused by climate change. Alteration in the rainfall patterns create unprecedented downpour. Increase in atmospheric temperatures causes mountain glaciers to melt.

Freshwater ecosystems are largely impacted by the melting glaciers. As most of us are aware, the Himalayan glaciers are the source for some of the great rivers in Asia such as Ganges, Mekong, Indus, Yellow and Yangtze. These are the main sources of drinking water for over a billion people and they rely on these rivers for farming, sanitation and also generation of hydro-electric power. Since glaciers are melting due to high temperatures, water is made less available in regions that depend on it during summer and spring (Figure 3.4).

Major rivers fed by Himalayan glaciers

Seven of Asia's major river systems begin in the Himalayan glaciers. The environmental impact of shrinking glaciers on the 1.3 billion people in the region is just now being measured.



Figure 3.4: Major rivers fed by Himalayan glaciers, (Source: McClatchy Washington Bureau, World Wildlife Federation, ESRI).

The quality of water is very important for ecosystems, health of human beings and other species and for many other purposes. Many of us may think that increase in temperatures will increase rainfall and rainfall is a good source for water. But the ultimate truth is that increased precipitation would result in increased flooding and these bring in more pollutants to the rivers thereby diminishing the quality of water. The river basins that have dams will hold water until it is needed; hence it helps in ceasing the entire water from getting polluted. The same impact occurs when there is heavy rainfall. The increase in water temperatures and increase in pollution can cause algal blooms and potentially increase the bacteria in water bodies (Figure 3.5).

Different regions may experience different impacts. Some places will have scarcity of water and some regions will see huge rainfall and more water. This is caused due to the temperatures and precipitation levels. If the global mean temperature rises by 2.7°F, the average annual stream flow will increase by 10–50% at higher latitudes and in some of the wet tropical areas. But at the same time, some dry regions at mid-latitudes and sub-tropic regions may see a decrease of 10–50%.

Increase in temperature puts oceans at risk. Oceans absorb 90% of the extra heat in the climate. Because of this absorption, oceans expand contributing to increase in sea level. The Cryosphere which is the frozen water on Earth is also melting. The Melting of ice and glaciers result in the unprecedented increase in sea level.

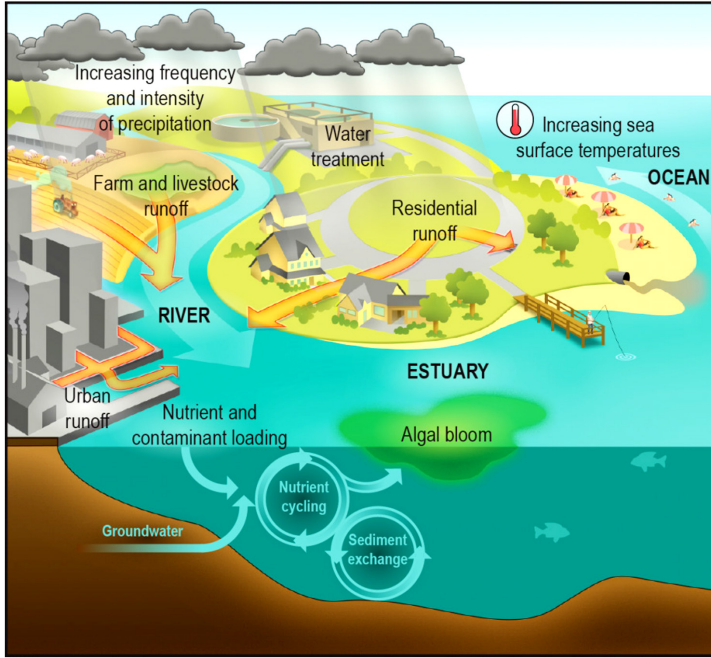


Figure 3.5: Impact of Climate Change on the Quality of Water, (Source: <https://health2016.globalchange.gov/>).

Melting ice turns the ocean water darker and so these waters absorb more sunlight than ice which makes the ocean hotter. This continues as a cyclic reaction. Since oceans suck up large amounts of Carbon dioxide from the atmosphere preventing them from moving to the upper atmosphere, they are considered to be the ‘carbon sinks.’ This process makes the water in the ocean more acidic. The ocean water is almost 40% more acidic than it used to be in the past (Figure 3.6).

It is predicted that sea level will rise another 1 to 4 feet by year 2100. According to records, it has already raised by 8 inches since 1880. High tides may combine with sea level rise leading to disastrous floods in the coming decades. Sea level will continue to rise even after 2100 as the oceans will take much longer time to respond to warmer conditions at the Earth’s surface.

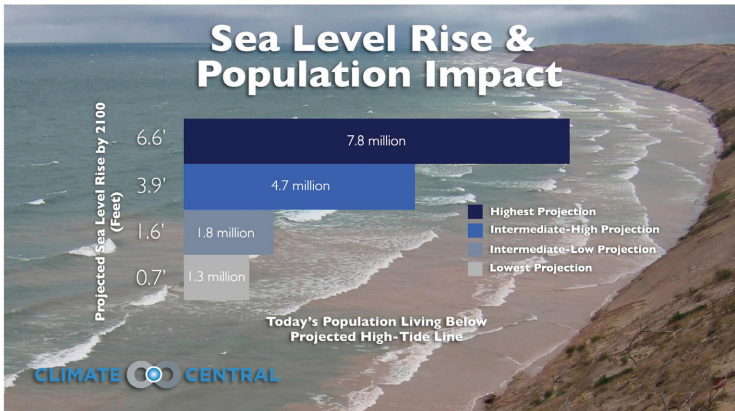


Figure 3.6: Projected increase in sea level by year 2100, (Source: <http://www.climatecentral.org/gallery/graphics/sea-level-rise-and-population-impact>).

As the sea level increases, salt water will be of great threat to other water bodies in the coastal areas and small islands. Hence society will need to look at ways of treating the water bodies in order to retain safe water for drinking purpose. Regions like South Africa, the Mediterranean regions and Northeastern Brazil will face the most consequences of water supply as there will be a decrease in the water resources in these regions.

3.2.2. Impact on Air and Atmosphere

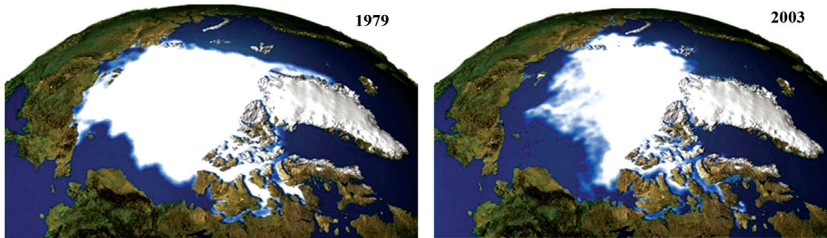
Similar to water, air is another important element of nature. If we analyze deeply, climate change first attacks the important elements of nature without which survival is impossible on this Earth. Climate change causes great damage to the quality of air. According to a study conducted recently, more than half of the global population will be exposed to increasingly stagnant atmospheric conditions. The quality of air will be of very poor quality in the tropical and sub-tropical regions.

Now what is air stagnation? Air stagnation occurs as a result of three meteorological incidents such as a stable lower atmosphere, light winds and a day with little or no precipitation to wash away pollution. It is anticipated that if the greenhouse gases are going to increase in future, then almost 55% of the world's population will experience more air stagnation by 2099. Majority of India, Mexico and the Amazon will see up to 40 more air stagnant days per year.

3.2.3. Impact on Polar Regions

Polar Regions see a greater amplification of Climate change. If the topic is climate change then there will definitely be special focus on the Polar Regions. Why Polar Regions are given so much importance? The reason is that the north and south extremities of the Earth is very crucial for regulating the climate of our planet and these two regions are most vulnerable to the impacts of climate change as well.

Even the average air temperature in the Arctic region has increased by about 5°C over the past 100 years. As per recent data, due to the rising temperatures, there will not be any sea ice cover left over in the Arctic for the next few decades. Before the middle of this Century, the Arctic may become ice free during summer (Figure 3.7).



Arctic Ice, September 1979 and September 2003
Credit NASA/Goddard Space Flight Center

Figure 3.7: Image representing reduction of ice in Arctic region, (Source: <http://asuperheroeveryday.blogspot.in/>).

Similar to Arctic, the Antarctic ice sheets play a significant role in influencing the Earth's climate. This single largest mass of ice which spans for almost 14 million sq.km accounts for nearly 90% of all freshwater on the Earth. These ice sheets reflect back sun's energy and helps in regulating global temperature. The melting of the ice even in small scale will have adverse effect on the sea level (Figure 3.8).



Figure 3.8: Antarctica, source of fresh water, (Source: <http://facts.zone/archives/1897>).

3.2.4. Impact on Forests

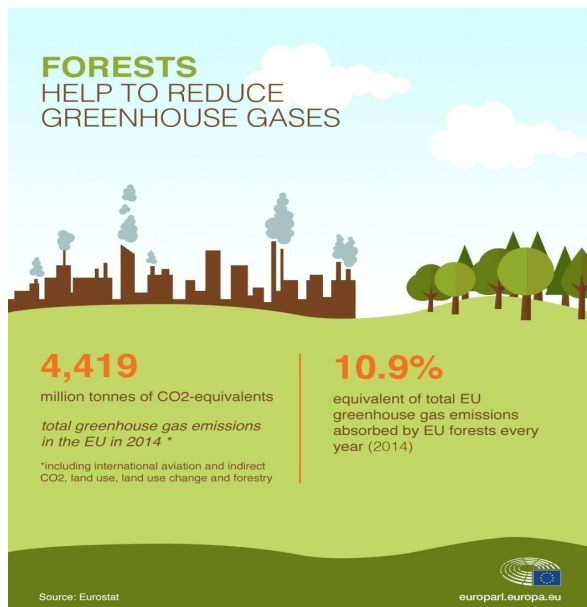


Figure 3.9: Importance of Forests, (Source: <http://www.europarl.europa.eu/news/en/headlines/society/20170711STO79506/climate-change-using-eu-for-ests-to-offset-carbon-emissions>).

Forests acts as a main tool safeguarding Earth from global warming. Carbon dioxide, one of the important greenhouse gases is the main culprit behind the climate change that is occurring now (Figure 3.9). Forests do great service to humanity and mankind by sucking up the Carbon dioxide from the atmosphere. Forests also form a habitat for thousands and millions of plants and animal species (Figure 3.10).

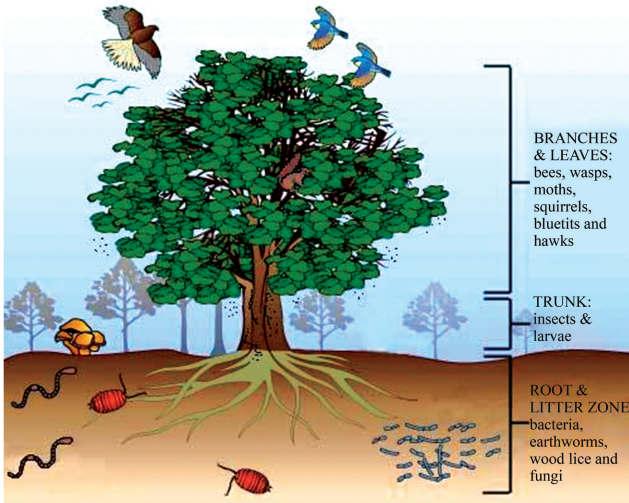


Figure 3.10: Picture representing tree as a habitat for various species, (Source: <https://lunanuvola.wordpress.com/2011/04/22/la-verita-sugli-alberi/>).

Climate change causes different impacts to different forests. In the tropical forests like Amazon, even a slight variance in the Climate can cause the extinction of various species as Amazon forest is known for its abundant biodiversity. Sub-Arctic boreal forests will also get badly affected with tree lines gradually retreating north as temperatures rise.



Figure 3.11: A fire in Zakouma National Park, Chad, (Source: <http://www.bbc.com/earth/story/20160722-why-we-should-let-raging-wildfires-burn>).

When forests are destroyed or get burnt due to heat waves caused by increased temperature, the species residing in it and the local community that rely on these forests for their survival also suffer (Figure 3.11). Since the heat waves have become more frequent in most parts of the world, trees need to be protected. Also the dying trees emit Carbon dioxide which is stored in them and this will add up to the already existing greenhouse gases in the atmosphere causing global warming. The burning of trees releases approximately 30% of all carbon emissions every year.

3.3. CLIMATE CHANGE IMPACT ON AGRICULTURE

We have seen in the above sections that climate change has great impact on water and temperature. As water and temperature are very much essential for agriculture, even agriculture is getting affected due to climate change. This impacts food production. Due to increase in temperature and drought, there is a decline in crop productivity. On one side there is low yield due to drought and on the other side the crops get damaged due to floods. Due to drought, farmers are forced to plant different crops. Even today we can see that many farmlands remain unused due to non-availability of water. Low production of crops results in shortage of food which affects the society.

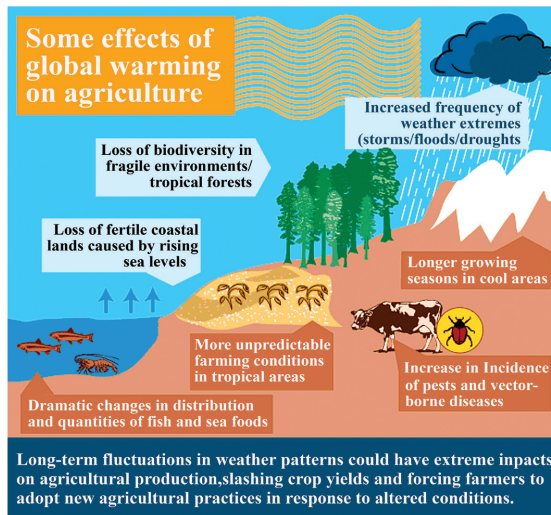


Figure 3.12: Impacts of climate change on agriculture, (Source: <http://blogs.nelson.wisc.edu/es112-301-southafrica/climate-change-2/agriculture/>).

Although the impacts are different, climate change is a great threat to agriculture (Figure 3.12). This directly affects the farmers as they depend upon irrigation/ farming for their livelihood. We hear many stories of farmers committing suicide just because of failing crops and they do not know any other means of living. Such incidents are more in developing countries like India. Farmers struggle to understand the shifting weather patterns and plant their crops according to it. Irregular rainfall is also another cause for damage of crops.

Each crop has its own unique growth pattern. For example, wheat and rice requires high temperatures to grow well whereas maize and sugarcane grow in cold climate. Cereal crops yielding are projected to increase at middle and high altitude regions and decrease at lower altitude regions. Crop yielding in general are likely to decrease in dry and tropical regions. It is further anticipated that wheat crops productivity will decrease at 35% by 2050 in some African countries (Figure 3.13).

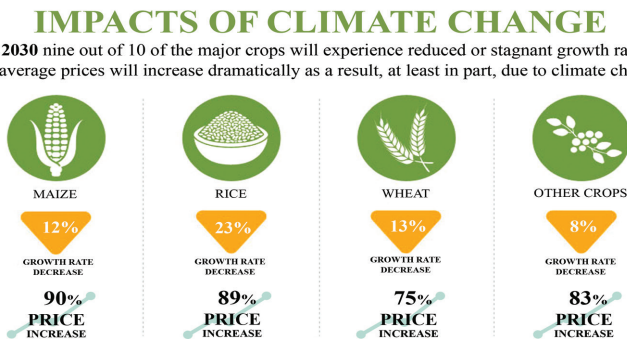


Figure 3.13: Impacts of climate change, (Source: <https://briandcolwell.com/2016/11/climate-change-and-large-scale-adoption-of-big-data-hydroponics/.html>).

The climate change could harm the growth of plants to such an extent that some countries may not be able to harvest enough crops to feed its people. There will not be enough food and people will starve without food. South-east Asia, China, Brazil and some parts of Africa are likely to be affected more and many people would suffer from hunger (Figure 3.14).

50% decline S. Africa crop yields by 2020s

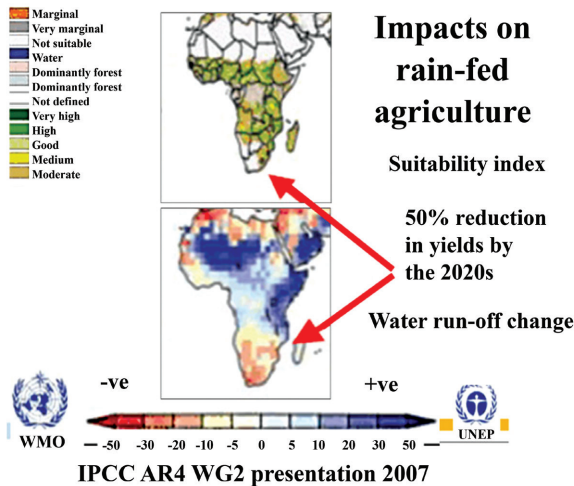


Figure 3.14: Projected impact on agriculture in South Africa, (Source: <http://www.climatechange-foodsecurity.org/africa.html>).

There have been changes to the duration of frost-free season and growing season in some parts of the world since 1980. This alteration is very commonly found in the Western United States. This change in the length of seasons affects the agriculture as well as ecosystems. The growing season is expected to lengthen across United States by the end of this Century. The Northern Great Plains may also get slightly affected due to the increase in the seasons. These occur because of the increase in the gas emissions which trap the heat and when the gas emissions reduce, the impact will be minimal.

Other than crops, fisheries also form a part of food supply for many countries. Fisheries also get its share of impact due to climate change. Increase in the ocean temperatures has already shifted some marine species to cooler waters. Decreasing water quality due to increase in sea level also affect the marine species. The local communities that depend upon fisheries for their food gets largely affected. For example, the Lower Mekong delta in Asia is the largest freshwater fishery in the world and more than forty million people depend upon the fish caught in this delta.



Figure 3.15: Mekong delta in Southeast Asia, (Source: <https://www.seafood-source.com/commentary/what-is-threatening-mekong-delta-fisheries>).

Since humans cannot exist without food, the impact of climate change will lead to food insecurity (Figure 3.15). With the decrease in food supply, the demand starts increasing and this will lead to conflict between nations in acquiring more food to satisfy their own people. Poor nations which cannot compete with the powerful players will suffer. Utilization of food becomes more difficult due to less availability.

3.4. CLIMATE CHANGE IMPACT ON COASTAL REGIONS

Coastal areas are of great benefit to the society as well as natural ecosystems. But they are already affected in a number of ways and climate change is adding fuel to it. Due to the growing population and likeliness to seashores, many people are building homes nearby coastal areas. In order to make their life happy, these people are unknowingly damaging the privacy of seas and oceans and are affecting the ecosystems of marine species living in the waters. Where there is human activity, pollution cannot be avoided. The infrastructures built by man, erosion of shores, pollution of water are some of the other problems occurring in the coastal regions (Figure 3.16).



Figure 3.16: Human development in coastal areas, (Source: <https://www.economist.com/news/united-states/21579470-americans-are-building-beachfront>).

homes-even-oceans-rise-youre-going-get-wet).

Climate change cause serious effects on the oceans as well as the coastal areas and make the situation even worse. Sea level is always on the rise due to increasing temperatures and melting of snow; frequency and intensity of storms varies much in the coastal regions, ocean temperatures are warming up and there is an increase in precipitation. When sea level rises, it increases the salinity of ground water and pushes the salt water further upstream.

There are high chances of salt water to get into freshwater wetlands. High salt content makes water undrinkable and it is also harmful for aquatic plants and other species. Sea and oceans forms the habitat for many species; coastal waters continue to warm even in the 21st Century and this warming leads to many changes in the environment thus causing trouble to all these species. Increase in salt water worsens coastal erosion, builds up sediment and affects the tidal connections between land and sea (Figure 3.17).

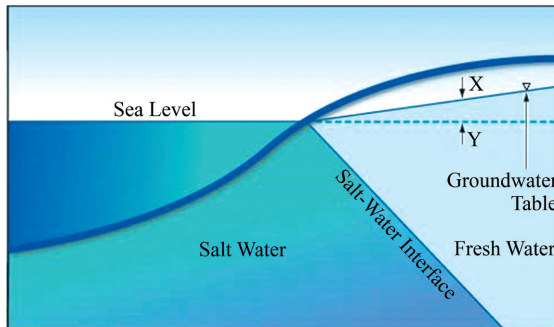


Figure 3.17: Picture representing salt water–fresh water interface due to rise of sea level, (Source: <https://blogatgeocene.net/2012/09/09/fresh-water-from-a-well-in-the-sea-at-rameswaram/>).

Also since Oceans absorb most of the Carbon dioxide from the atmosphere, the ocean waters become more acidic and this is not at all good for the coastal population and the marine ecosystems. Coastal habitats face cumulative obliteration because of change in climatic conditions. Estuaries (area where salt water and fresh water mix up), beaches, wetlands, mangroves, reefs, seagrass meadows and salt marshes, all come under coastal habitats. These coastal habitats are the real form of connections between land and sea. The coastal habitats are the direct victims of climate change impact as they are at risk due to coastal development and polluted water (Figure 3.18).

5 Critical Estuarine Coastal Ecosystems



Figure 3.18: Critical Estuarine coastal ecosystems, (Source: <https://www.slideshare.net/anaveroa/the-value-of-estuarine-and-coastal-ecosystems-9379254>).

The uniqueness of estuaries is spoiled by the diversified patterns of rainfall and floods. The size and timing of rainfall determines the flow of freshwater to estuaries and other habitats. The timely flow and the volume are very important as this determines the supply of essential nutrients for coastal productivity. When the water passes down through rivers, all the nutrients and soil are accumulated and gets settled in estuaries and coastal waters.

Since the coastal habitats are all linked to each other, the Great Barrier Reef is also directly affected by the changes in the rainfall patterns. Hence any small impact that is caused through climate change will be felt and passed through the entire coastal region. All the coastal habitats are facing enormous changes. It has become a routine that the sediments getting washed out from the land accumulates in estuaries and then flushed to sea due to large floods and then accumulate again there.

Extreme weather conditions have a high risk on human as well as marine life. Fish stocks, maritime industries are all in the pipeline of damage. For example, one fifth of the European Union's coastline is severely affected and it is retreating between 0.5 and 2 meters per year. The sea level increase has adverse effects on the people as well as GDP of the country. In EU, one third of its population lives within 50 km of the coast and this population generates over 30% of the total GDP of European Union.

In some areas, due to warming of coastal waters, fish and other marine species have already shifted their habitats. Halibut, Rock sole, Pollock,

Snow crab in Alaska and Mangrove trees in Florida are some of the species that are already in the process of shifting their habitats. As most of the southern species are moving northward, many other species are also expected to change their base as the resources are limited and there will be more competition (Figure 3.19).



Figure 3.19: Tropical plant-eating fishes moving towards temperate waters, (Source: <http://nwcoastenergynews.com/2014/07/08/6540/tropical-fish-climate-change-migration-growing-threat-kelp-beds-study/>).

When the coastal habitats start destroying, the coastal settlements will be at risk. Some have adapted to cope with the changes but for how long they can adapt when the changes happen very frequent depends on the situation (Figure 3.20).

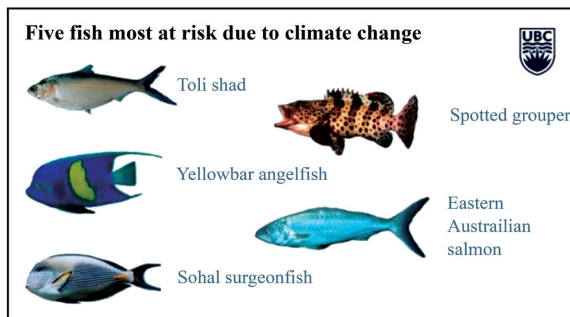


Figure 3.20: Fishes at risk due to climate change, (Source: <https://tepbac.com/tin-tuc/full/co-hon-294-loai-ca-bien-bi-anh-huong-boi-bien-doi-khi-hau-23091.html>).

All industries in the coastal areas will start to deteriorate. The transportation of goods through oceans and seas, fish cultivation, offshore energy drilling, recreation and most importantly tourism are some of the industries which have impact on the GDP of the country if affected due to climate change. The sea level increase will have bad effects in both developing and developed countries. Countries such as Bangladesh, Netherlands and Guyana are at very high risk.

The fastest rate of sea level rise is seen in some areas of United States where the land is sinking. For example, in coastal Louisiana, in the last fifty years the relative sea level has risen by more than eight inches which is about twice the global rate. Manmade developments along the coast block the migration of wetlands and change the amount of sediment delivered to coastal areas. This is what had exactly happened in coastal Louisiana. The coast has approximately lost 2000 square miles of wetlands in recent years as the alteration of the Mississippi river's sediment system by humans and the extraction of oil and water has caused the land to sink. Due to these changes wetlands do not receive enough sediment to balance the rise in sea level and it cannot function as a natural buffer for flooding. In the Chesapeake Bay area, the subsiding land worsens the effects of relative sea level rise, increasing the risk of flooding in cities, inhabited islands, and tidal wetlands (Figure 3.21).

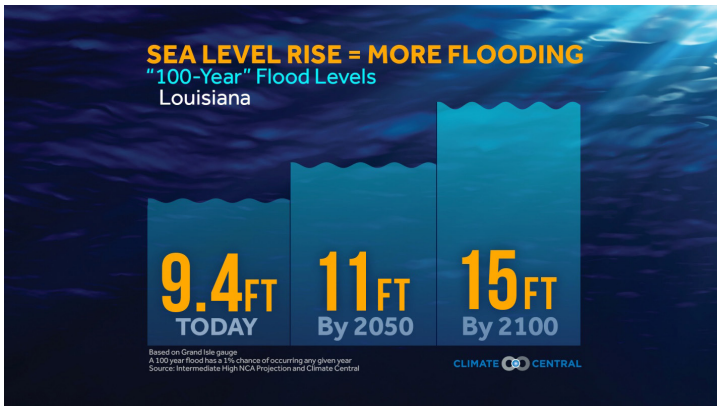


Figure 3.21: Analysis of sea level rise in Louisiana, (Source: <http://www.climatecentral.org/gallery/graphics/10-year-anniversary-of-hurricane-katrina>).

The growth in population and development in the coastal regions makes the climatic change impact even more severe. Because of the development in the coastal areas, the natural systems lose their ability to respond to climate

changes. Every creation in nature has a purpose; when we test or alter the creation the purpose remains unfulfilled.

3.5. CLIMATE CHANGE IMPACT ON WILDLIFE

The major setback created due to climate change is Global Warming. Although the climate change impact is equally impacting everyone, the first to feel and respond to the effect is the wildlife. Experts in this field are quite firm that the major cause for the extinction of various species in this Century is global warming. According to the Intergovernmental Panel on Climate Change, an average increase of 1.5°C rise in temperature may leave 20–30% of species at risk of extinction. If this increase goes beyond 3°C, then it becomes a great cause of concern for most of the ecosystems which keeps this planet alive.

We are already losing our ecosystems due to deforestation and different kinds of pollutions. The ecosystems are the base that provides clean water, pure air and valuable soil; hence when the ecosystem is impacted all the other sources are damaged as well. As we humans are adapted to live in a particular temperature, even the wildlife creatures have their own way of living. When there is variation in the temperature they move towards a more suitable place for living or die in lack of likeable habitat. Since the warming has also caused changes to the seasons and the length of growing seasons, availability of food and water also becomes an important problem for the wildlife animals. Endangered species, coral reefs and polar animals are most vulnerable to the impact of climatic changes (Figure 3.22).



Figure 3.22: Picture representing change in migration pattern of animals, (Source: <https://helpsavenature.com/global-warming-effects-on-animals>).

Many studies were conducted and it is identified that many of the species that are considered endangered are living in areas where the climate change impact will be felt severely. Also the changes are so quick that it is not easy for the animals and species to adapt to it so easily. Due to heavy rainfall, many animals are forced to leave their habitats and some become extinct in the process of migration. Scientists across the globe are already studying the past climatic changes and the way wildlife has responded to it to understand and analyze the impact of modern day changes. There have been a lot of changes in the animal behavior and migration pattern among most of the other species.

Trees in the forest also go through many changes. The long droughts make trees weaker with lower defense mechanisms. Hence they are easily attacked by tree killing insects. The climatic changes such as long summers and mild winters support the survival of these insects. The warmer weather, weak trees and these insects are suspected to be the cause of the destruction of 70,000 square miles of Rocky Mountain conifers (Figure 3.23).



Figure 3.23: Mountain pine bark beetles and larvae damage a pine tree, (*Source: <https://www.minneapolisfed.org/publications/fedgazette/the-beetle-and-the-damage-done>*).

Habitat is very important for the wildlife to thrive. Habitat does not only mean the living place. It includes everything right from suitable climate, environment, landscape, availability of other essential things like food, water, etc., Habitats influences the status of the species. Not only the native species but even the species arriving from other locations will be able to settle in new habitats only if the habitats fulfill their requirements else they have to learn to adapt. But adaptation takes time; it is also not so easy

considering the speed at which the climate changes.

As per the Federal Agency for Nature Conservation estimates, there will be a reduction of 30% of the native species in Germany, the main reason being scrappy landscapes and climatic change impacts. This is a matter of concern as there is already a great threat for huge number of species. Let us see some of the challenges faced by wildlife due to the owing climatic changes:

3.5.1. Asian Rhinoceros



Figure 3.24: A One-horned Rhino in Nepal, (Source: <https://news.mongabay.com/series/asian-rhinos/page/2/>).

The one-horned rhinos that live in northern India and Nepal depend upon the grasslands for their living (Figure 3.24). The usual annual monsoons bring sufficient rain in these regions and support the regular growth of the vegetation upon which these rhinos feed. But the change in climate may have impact upon the rains and may cause shift in seasons bringing floods or drought. Both causes disruption in the life of these rhinos and they will find no other way than to find some other suitable place to continue their living.

3.5.2. Indian Tigers

We can see that there is a huge decline in the number of tigers (Figure 3.25). More than 3200 tigers are killed by poaching or loss of habitat. Wildfires occurring in the dense forests due to the increasing temperatures may take away the lives of the remaining ones. Because of the rapid decrease in the count of tigers, many campaigns are conducted to emphasize the need to ‘save the tigers’ initiative.



Figure 3.25: Indian tiger, one of the endangered species, (Source: <http://www.greenpeace.org/india/en/>).

Orangutans in Borneo

In Borneo where Orangutans are found in large numbers, these animals are already facing the risk of deforestation, conversion of forests and also hunting. Large parts of the original forests have been taken away and replaced by palm oil plantations, or cities and villages. One of the most important impacts of climate change likely to occur in Borneo is shortage of food for Orangutans caused by irregular rainfall patterns (Figure 3.26).



Figure 3.26: Orangutans in danger, (Source: <http://sacredseedlings.com/corporations-plan-to-destroy-orangutan-habitat/>).

3.5.3. Snow Leopards in Himalayas

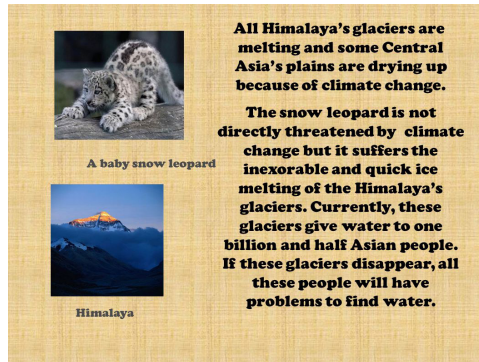


Figure 3.27: Snow Leopard, (Source: <http://slideplayer.com/slide/11182119/>).

As the name suggests, these leopards live in snow covered regions. Snow Leopards are mostly found in the Himalayas. The Great Himalayas have already started warming and if this continues, the range will shrink and the trees may move further up the mountains. This may isolate the snow leopard population and even its prey will get affected.

3.5.4. African Elephants

Africa experiences extreme temperatures; sometimes there will be heavy downpour of rain bringing floods and sometimes there will be too little rain causing droughts and wildfires. Because of these extremities, some places become unsuitable for specific species to live in. As the African elephants would require 225 liters of water every day, when there is no rain, these elephants are forced to move to other locations out of their habitat in search of water (Figure 3.28).

Sometimes they come to people living areas in need of water and might get killed due to fear. This is a commonly occurring scenario throughout the world now. Humans occupy large areas including the habitats of animals and hence animals have started to enter the villages and towns for their needs but these poor animals are killed for no fault of theirs.



Figure 3.28: African elephants in search of water, (Source: <https://www.wwf.org.uk/wildlife/african-elephants>).

3.5.5. The Arctic Polar Bears

Polar bears depend largely on the sea ice. Due to warming of the region which is twice as fast as the global average, the Arctic ice is melting earlier and forms again very late every year. Because of this the female bears find it difficult to get onto land in late autumn to den and onto the sea ice in spring to feed (Figure 3.29).



Figure 3.29: A starving polar Bear, (Source: <https://stevedalepetworld.com/climate-change-not-real-ask-alpaca-polar-bear/>).

Their food sources decrease due to melting of ice. This makes the bears fast for longer period resulting in reduction in their body weight. With a much weaker physical condition, it becomes extremely hard for the bears to survive in the summer seasons. This leads to the rapid extinction of polar bears, one of the beautiful creations on Earth. Mammals that depend on ice also suffer. It is to be noted that in the year 2008, the Polar bear became the first animal to be included in the Endangered Species Act list of threatened species as a result of global warming.

3.5.6. Adelie Penguins



Figure 3.30: An Adelie Penguin feeding its chick, (Source: <https://www.tree-hugger.com/climate-change/climate-change-could-reduce-adelie-penguin-populations.html>).

Adelie Penguins means ‘true Antarctic Penguins’ a name given to them as they live most of their life in Antarctica. Krills are the main food source for the Adelie Penguins and these Krills breeds and feeds under the sea ice. Melting of sea ice is one of the major impacts of climate change and when the sea ice reduces, the Krills cannot survive which means there is a shortage of food for the Penguins. Survival becomes hard for Adelie Penguins without proper food.

Coral Reefs

Coral Reefs are highly at risk due to climate change because they are much sensitive even to the smallest change that happens to the ocean’s temperature. Corals get their nourishment from algae and it is the algae that give the corals its lively colors. Over heat in the oceans stresses the algae and so it leaves causing an event known as bleaching wherein the corals start to starve. As we know, the coral reefs are also home to many other species including fish; hence any harm to the corals would harm all these marine species (Figure 3.31).

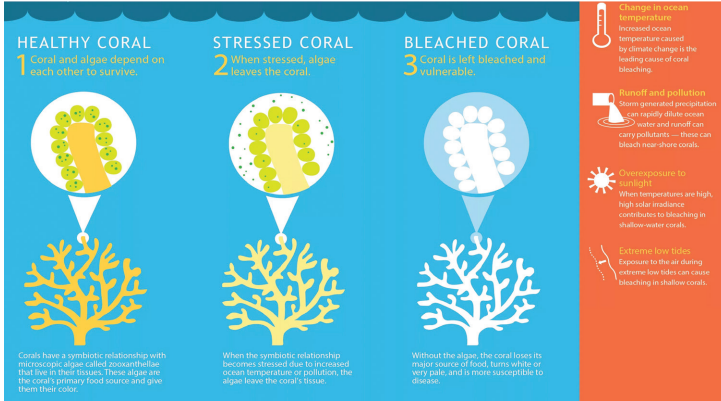


Figure 3.31: Picture representing coral bleaching, (Source: <http://vifreepress.com/2016/06/experts-expect-coral-bleaching-continue-record-third-year/>).

Also the increase in acidity of oceans due to more absorption of Carbon dioxide causes an imbalance in the calcium content. This affects the species with calcified shells such as shellfish and coral because they do not get enough calcium to grow. In any way, climatic change causes more damage to the corals and the various impacts eventually leads to the death of corals.

If the current global warming progresses in the same direction, then there will be only 5% left out of one of the world's largest coral reef, the Australia's Great Barrier Reef by the year 2050. The vanishing of coral reefs is not only a danger for the marine species but also for half a billion people who are relying on the fish from the reefs as a source of protein (Figure 3.32).



Figure 3.32: Grave barrier reef, a campaign to protect the great barrier reef from extinction, (Source: <http://akirameow.blogspot.in/2015/04/lush-grave-barrier-reef-lifes-beach.html>).

Many species both marine and terrestrial have started to migrate to different location due to climate change. Some have started to adapt to the

changing seasons. If we analyze carefully, we can see that the color of some species are changing. For example, the colors of butterflies are changing because in warmer temperatures dark-colored butterflies heat up faster than light-colored butterflies. Similarly there has been a change to the size of some animals. Salamanders in Eastern North America and cold water fishes are shrinking in size because being small is more favorable in hot temperature than when it is cold (Figure 3.33).

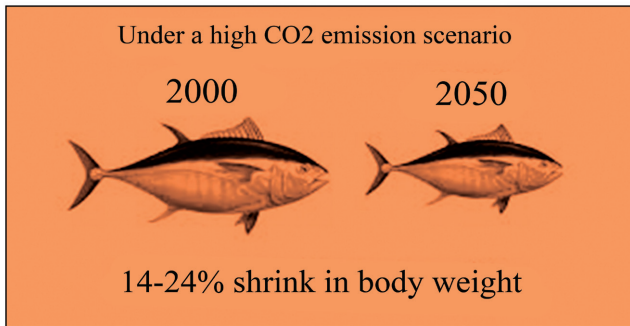


Figure 3.33: Reduction in size of fish due to climate change, (Source: <http://www.dolphinaris.com/fish-shrinking-in-size-due-to-climate-change-consequences-to-ocean-acidification-dolphinaris-in-barcelo/>).

In fact, when looked overall, there is a slight reduction in the species of cold regions and increase in the species of warmer regions. The cold loving Kelp forests of Southern Australia, Japan and North-west coast of U.S. have totally collapsed due to extensive warming and its restoration is also not possible since the native species of these forests are now adapted to warmer waters.

From all the above examples and scenarios, it is very clear that even a small climate change has a profound impact on the species. The changes may seem very minute but when all of the species gets affected it then leads to the destruction of the entire ecosystem.

3.6. CLIMATE CHANGE IMPACT ON THE HEALTH OF HUMANS

Any tiny change in the weather and atmosphere has its influence felt on the environment and so humans who largely depend upon all these factors are affected. Because of the climate change, the health of humans is at a toss. With the variations in the climate and its chain reactions, the mortality

rate increases. The rising temperatures, pollution, poor water quality, spread of diseases by virus and mosquitoes – all contribute to the health hazards. The World Health Organization points out that the health of people living in low-lying and coastal areas is more vulnerable to diseases. Also people in countries where there are no adequate medical facilities will also suffer (Figure 3.34).

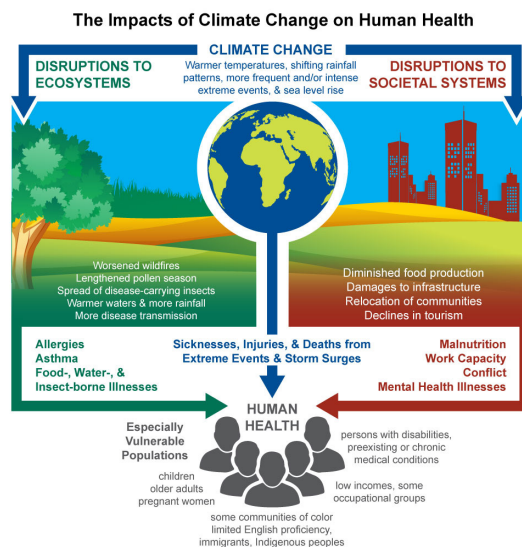


Figure 3.34: Climate change impact on human health, (Source: <http://blogs.edf.org/climate411/files/2016/04/Health-Threats-from-Climate-Change-graphic.jpg>).

The shoot up of temperature is a main villain to the human community. High temperatures cause heat waves and also cause mental stress in people. Many people get skin allergies and in worst cases die due to extreme heat waves. The heat waves that tormented Europe in year 2003 almost killed fifteen thousand people in France alone. Heat causes wildfires and destroys forests which even leads to breathing problems and aggravates cardiovascular and respiratory diseases.

Heat related health impacts are found in many regions of Europe, North America, Australia and South Asia. Also the poor people who work outdoors like farmers and construction workers, children and women are the ones that are mostly affected due to the scorching heat as they cannot afford to an air-condition and also they are physically weak to tolerate the heat. According to records, almost close to one fifth of human population in the world is

living below the extremely poverty line as measured by the World Bank earning less than \$1.25 per day. People living in such income scale will mostly depend upon publicly available resources like water, transportation, food, etc., for their day-to-day life. When changes in the climate disrupt these resources, these people who depend upon them get affected.

Older adults and young children are easily affected by extreme heat. Warm temperature pollutes air; a warm atmosphere increases the smog formation (ground-level ozone) in polluted regions. Smog is not good for lungs and it triggers asthma attacks. Also wildfires caused by heat waves generate smoke and it lowers the quality of air. Polluted air causes respiratory and neurological problems in humans (Figure 3.35).

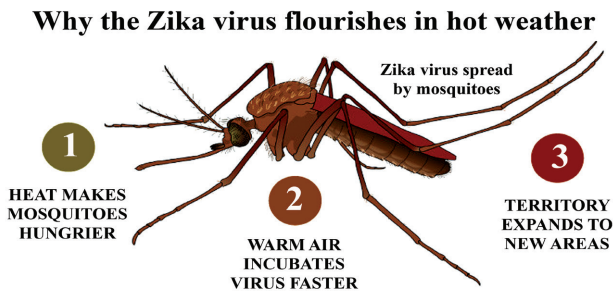


Figure 3.35: Example for virus threat in hot weather, (Source: <http://www.momscleanairforce.org/zika/>).

Disease causing bacteria finds warm freshwater to be more suitable to grow and it also contaminates drinking water. Today's climatic changes causes increase in the temperature and rainfall and so many life-threatening diseases like malaria and cholera spreads. The mosquitoes that spread malaria virus thrive in hot and humid conditions. The Environmental Protection Agency and the Centers for Disease Control has already warned the governments on the various impacts of climate changes such as variation in temperatures, poor quality of air and water, and about various infectious diseases. Meningococcal meningitis is an epidemic which is often linked with drought. Sub-Saharan countries and countries in West Africa are more vulnerable to Meningitis as drought is more common in these areas.

Similar to drought, changes in precipitation patterns also cause health problems. Diseases such as dengue, malaria which is spread by mosquitoes increases when there is more precipitation and floods. Rainfall and floods contaminate water and causes diarrhea particularly in children. Compared

to men, the mortality rate of women are high as they are physically much weaker and are affected by extreme climatic changes. Also undergoing climatic disorders while they are pregnant puts them at more risk.

Malnutrition is another problem caused by climate change especially in developing countries. Due to droughts and floods agriculture gets affected; crops are failing. Excessive rain washes away the topsoil from the land making it more difficult for farmers to cultivate crops. All these leads to insufficient food and people have to remain hungry and the worst part is that many children suffer from malnutrition (Figure 3.36).

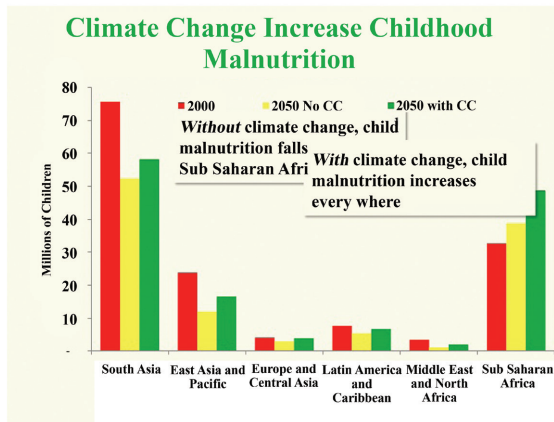


Figure 3.36: Increase in malnutrition among children due to climate change, (Source: <https://www.slideshare.net/ifpri/climate-change-and-agriculture-impacts-and-costs-of-adaption>).

Out of all the health problems that occur to humans because of climate change, mental health problem is something that is not known to the outside world. Many people who are survivors of tsunamis, cyclones, extreme floods or any other severe climatic event often would have lost their homes, families and everything. These people will definitely be under great stress and depression. Since it is less known, it gets unnoticed and underestimated. In developing countries where there are less medical camps after a disaster, these symptoms are not even identified. As the climatic changes are continuing, this problem is likely to increase.

3.7. CLIMATE CHANGE IMPACT IN BUSINESS AND OTHER INDUSTRIES

All the resulting actions of the climatic changes as we saw in the earlier

sections have a direct impact on the business world. The extreme and unpredictable weather conditions are a challenge for the normal execution of business operations. Every corporate and multinational company will have a Business Continuity Plan (BCP) mandatorily for the smooth functioning of its operations in case of any unexpected events which includes natural calamities and all their staffs will be trained to handle such situations. Many companies are already changing the way they work because of the threats anticipated due to climate change. For example, in Miami, work is going on to re-built wastewater treatment plants, seawalls are being raised foreseeing the future impacts that may cause by floods.

Every industry right from finance to health is about to shake due to climatic variations. Price water house Coopers (PwC), one of the largest professional services firm states that, “Now one thing is clear: businesses, governments and communities across the world need to plan for a warming world – not just 2°C, but 4°C or even 6°C.” According to PwC’s latest reports, a carbon reduction of 5.1% per year is required if we are to limit the temperature rise to 2°C. But this is not happening; in spite of economic slowdown there’s been a reduction of only 0.7% every year. According to Malcolm Preston, PwC’s global lead on sustainability and climate change.

“Even with progress year-on-year in emissions reduction, the reality is that the level of corporate reduction is nowhere near what is required. The new normal for businesses is a period of high uncertainty, subdued growth and volatile commodity prices. If regulatory certainty doesn’t come soon, businesses’ ability to plan and act – particularly around energy, supply chain and risk – could be anything but ‘normal.’”

A report on The Carbon Disclosure Project’s analysis of FTSE 100 companies identified that nearly 80% of the companies see climate change as a risk to their business. But out of these companies, only half of them have so far have incorporated the protective measures. Ford Motor Company confesses that climate change trend is shaping their strategy for future markets. The Company further states that, “Unless the emission of greenhouse gases are stabilized, global temperatures is going to increase. Increasing population and the improvement in their standard of living would need more natural resources.” Dislocation of goods will hinder the services.

Pharmaceutical Companies may need to think strategically and work depending upon the climate change. As the health hazards and diseases are to vary depending upon the extreme weathers, Pharmaceutical companies may face many challenges. The Securities and Exchange Commission

reports that the weather patterns throughout the world will change because of the climate changes. There will be severe storms. The extreme weather will cause great loss to the insurance companies. It is even hard to predict how different industries are to be affected. The impacts caused by climate change in part of the world may have its consequences felt on the other side. For instance, the earthquakes that hit Japan in April 2016 made many auto giants to suspend its production even in other branch companies. When the Great Plains in the United States was hit by severe drought in 2011, many meat-processing plants had no other options than to close or re-locate.

Majority of the companies are not designed to work in an extreme storm or during very heavy rainfall or the staffs of the companies are trained to work under those conditions. Daniel Kreeger, the Executive Director of the nonprofit Association of Climate Change Officers says that, "Despite the size of the challenge, fewer employees are trained in incorporating climate patterns in their planning for the future than should be. We don't have the right people with the right skills in the right places." No educational institution or technical training institutions teach this. But this may emerge as a new skill that is required to continue productivity in companies when there are adverse situations like this.

Companies and industries will also face demand for new goods more specific to the changing climate. Rising temperatures will reduce the demand for cold weather products and increase the demand for summer clothing.

Business world will remain uncertain unless there are proper contingency plans in place to face the upcoming events due to extreme weathers. Only if the strategies are going to be swifter and bold, the industries can sustain. Even if so much caution is practiced, we will not be able to know the magnitude of consequences as the climate change impact is going to be so large, says John Steinbruner, Professor at the University of Maryland and Chair of the Committee on International Security Studies of the American Academy of Arts and Sciences. 66% of the executives surveyed as part of the Global Resource Challenges Report said that climate change had affected the resources of their businesses. But only 11% said climate change had increased the priority of resource management.

Climate change will slow down the services and the economic growth of the countries. Globally there will be a reduction in the income by 23% by the year 2100. According to another study, an increase of 4.5°C in global temperature would reduce the GDP by \$72 trillion. The reason behind such reduction would be the effects that each individual company

faces. Unpredictable weather will only intensify these effects, reducing the availability of raw materials and disrupting supply chains. Tourism industry will get severely affected due to climate change (Figure 3.37).

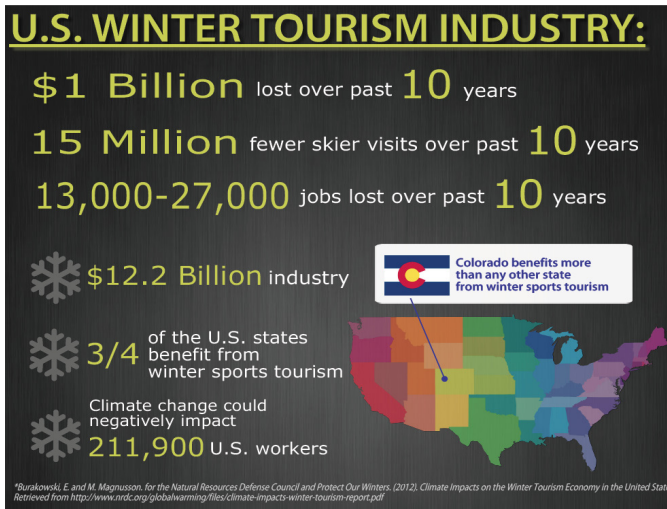


Figure 3.37: Decline in tourism industry due to climate change, (Source: <https://www.wyofile.com/climate-change-casualty-ski-industry-stands-lose/>).

It is predicted that there will be a shortfall in the prime resources that the industries depend on. Mainly there may be a shortage in the oil supply by 2020, water supply may fall short by 40% by 2030 and there will be a decline in the rare metals that is used in electronics and batteries today. No industry can escape this change; hence the climate change matters more to the business world.

3.8. CLIMATE CHANGE IMPACT IN DIFFERENT REGIONS

Although Climate change is a globally occurring phenomenon, there is difference in its impact across various regions. Some general studies indicate that climate change does some favorable changes to the regions that are colder today as cultivation becomes easier there but warmer areas may face shortage of food and water, high mortality rates and more natural disasters.

Let us now see some of the climatic change impacts in various countries:

3.8.1. Climate Change Impact in Africa



Figure 3.38: Climate change impact in Africa, (Source: <http://www.grida.no/resources/7721>).

Africa is projected to be the most vulnerable continent to climate change (Figure 3.38). Poverty, reduction in food supply and degradation of ecosystem are found even today in Africa. By 2050, nearly 600 million people may get affected from water scarcity due to climate change. Since rural areas will be severely affected, people will start moving to urban areas increasing the urban population. The population in urban area is expected to increase by 800 million people and so the available sources in urban areas will become insufficient. The sea level increase may affect the densely populated low-

lying areas such as Senegal, Mozambique and Liberia towards the end of the 21st Century. Also the health of people will get even worse with the spread of many diseases and due to malnutrition.

3.8.2. Climate Change Impact in Asia

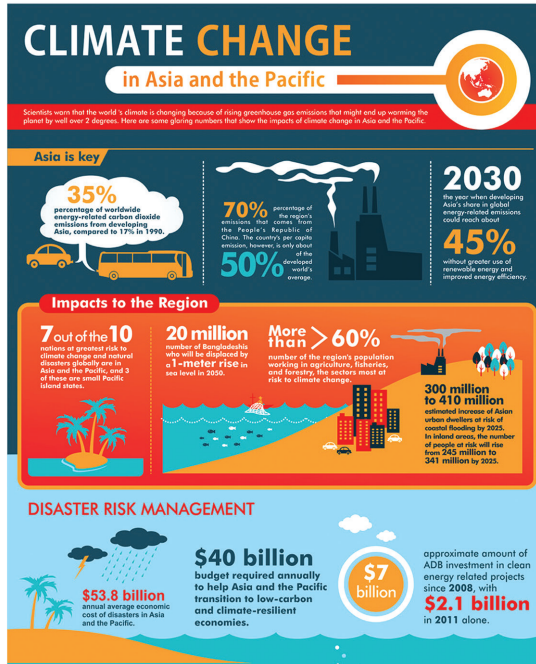


Figure 3.39: Climate change impact in Asia, (Source: <https://occupytheory.org/asia-climate-change-facts-and-statistics/>).

One of the major impact of climate change in Central and South-east Asia is the decrease in freshwater for consumption. As the population is constantly growing and also with the high standards of living, the less availability of freshwater will likely impact more than a billion people by year 2050. Another important area to worry about is the retreating of glaciers. In Asia, the mountain glaciers are retreating at a faster rate than ever recorded in history. Melting of glaciers will increase the risk of floods in the highly populated coastal areas of South and South-east Asia. Agriculture and production of crops will differ across regions depending on the weather. By the middle of 21st Century, the crop yield increase will go up to 20% in East and South-east Asia whereas it will decline by 30% in Central and

South Asia due to climate change. Of course there will be more number of deaths due to health related problems in East, South and South-east Asia.

3.8.3. Climate Change Impact in Australia

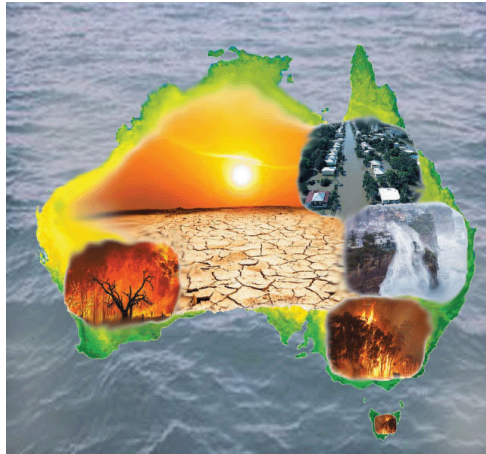


Figure 3.40: Climate change impact in Australia, (Source: <https://antinuclear.net/2017/07/17/climate-change-to-which-nuclear-power-is-irrelevant-theme-for-august-2017/>).

We have already discussed in the earlier sections the possible impact of climate change on Australia's Great Barrier Reef. The changes in climate will have its effect on the ecological systems and the reefs and the wet tropical regions of Queensland will be at high risk by 2050. Areas such as Cairns and South-east Queensland will be hugely affected due to coastal development and increase in sea level. This will do more harm to the residents and would cause severe damage to the infrastructure. Already drought has been declared in many regions of Australia and drought for a long period is the main reason behind suicidal of male farmers in Australia. Heat waves and extreme storm events may add up to the destructions. Water related problems will intensify in South-western and South-eastern Australia.

3.8.4. Climate Change Impact in New Zealand

Northern and some Eastern parts of New Zealand will face water scarcity with an average global warming of 1°C. Coastal regions such as Northland to Bay of Plenty will be at risk of floods due to increase in sea level. Northern and eastern parts of New Zealand will face problems in agriculture and

forestry production due to droughts and fire caused by intense heat. More electrical blackouts are predicted due to heat waves.

3.8.5. Climate Change Impact in Europe

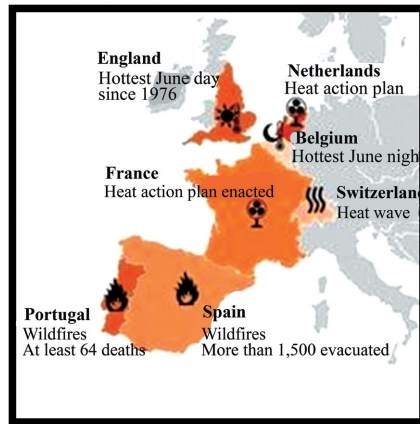


Figure 3.41: Climate change impact in Europe, (Source: <http://www.oerc.ox.ac.uk/news/June-heatwave>).

Europe is already facing a long list of impacts due to climate change including rise of sea level, retreating glaciers, increased heat waves, long growing seasons, change in species habitats, health problems, etc., Tourism is going to face more challenges in Southern Europe due to high temperatures and drought. Rainfall is expected to decrease in Central and Eastern Europe causing less forest productivity. Initially it was thought that Climate change would bring in both positive as well as negative effects on Northern Europe but continuous changes in the climate would create more damage which may overshadow the benefits. Floods may become more common during winters in Northern Europe. The Mediterranean region is becoming drier, making it even more vulnerable to drought and wildfires. There is a strong fear that overall all the European regions may face one or the other consequence of climate change.

3.8.6. Climate Change Impact in United States of America

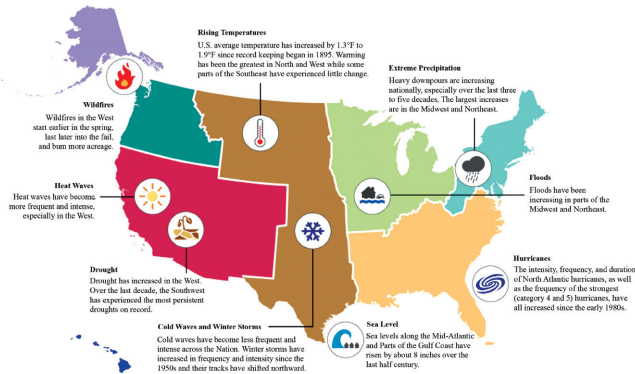


Figure 3.42: Climate change impact in U.S, (Source: <https://health2016.globalchange.gov/climate-change-and-human-health>).

In the drier regions of Central and South America, the land will get even worse due to droughts. Production of important crops such as maize and coffee is expected to decrease. Sea level rise will not only cause floods but also increase the salt content in drinking water. Many species will become extinct due to serious changes in the climate. Forest and wild fires are very much likely in North America. Intensity of heat waves will be more as the century passes and aged adults are particularly at risk. There will be reduction in the yield of various crops like corn, soy and cotton. High emissions scenarios project reductions in yields by as much as 80% by the end of the century. People will suffer from increased stress level and many of the climate change impacts will affect the tourism industry very badly.

Many small islands irrespective of their location will face severe destruction due to extreme climate changes. Tourism is a major source of income for these islands and this will badly get affected. In Caribbean and Pacific islands the demand for drinking water will increase due to poor rainfall. Coral bleaching will lead to reduction of fisheries and so the local people who depend upon them need to face the consequences.

Climate change has various stages and its level of impact varies across countries and species. But one thing is very clear that the planet Earth has already started to experience and will face more challenges due to the impacts of climate change. If humans think of preserving themselves and their environment from all these harms, then they need to act immediately. If they wish nature to do its duty, then they need to leave the nature as it is

and do not interfere in its system. By interfering into the Earth's system, humans are inviting trouble to them and for their future generations. Instead of learning their mistakes after falling in the ground in helpless situations, it would be wise if all nations and all people change their behavior and work for preserving nature. The trigger is already ignited but we can work to reduce its impact from destroying the earth fully by reducing human interventions that may cause disturbance to the climatic system.

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CHAPTER 4

A DETAILED STUDY ON GLOBAL WARMING

“When it comes to Global Warming, everybody wants to change the world but nobody wants to change himself.”

—Alfred Basha

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Global Warming is a hot topic not only in the tourism industry but generally. All the climatic conferences that are organized and participated by world leaders have ‘Global Warming’ as the main topic of discussion. Such is the importance of global warming in today’s world. This is not a new term; the term is in existence for quite a long period but people are paying more attention to it only recently as they have started experiencing its impact. Global warming is the main indicator of climate change and tourism industry contributes to global warming. This chapter will help us understand more about Global Warming – the cause and effect of it. We will get to know the overall impact of global warming. The chapter also throws light on the link between tourism and the greenhouse gases which causes global warming. We will also learn about the different ways by which we can reduce global warming and save our mother Earth.

4.1. GLOBAL WARMING: DEFINITION AND CAUSE

Our planet Earth is warmer than before. The temperature of both land and oceans are much higher than it has been in 1880 when the record keeping began. In general, the entire globe is heating up. This overall increase in temperature is called global warming (Figure 4.1).



Figure 4.1: Global warming, (Source: <https://allamericanenviro.com/what-is-global-warming/>).

Global Warming is explained in various ways and using different definitions. Let us first look into some of the definitions of global warming and understand its meaning (Figure 4.2).

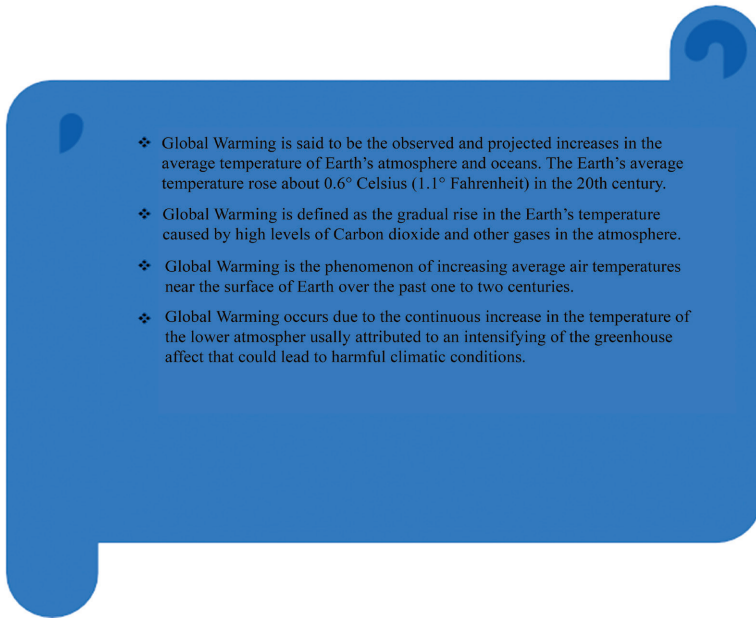


Figure 4.2: Global warming definitions.

People seldom confuse Global Warming with Climate Change; both are not the same but, global warming leads to climate change. By Global Warming, we mean the rise in the temperature of the Earth's surface whereas Climate change includes both man-made changes and natural changes. It includes global warming and the impact of global warmings such as melting of snow and glaciers, severe cyclones, heavy rains, floods and more frequent droughts.

Global Warming is nothing but a man-made problem to a much bigger issue of climate change. It specifies the warming caused due to the increased emission of Carbon dioxide and other greenhouse gases by usage of coal, oil and other gases. Much to our surprise, the natural occurrences like volcanic eruptions have only lead to cooling of Earth's surface temperature.

4.1.1. Causes of Global Warming

Global Warming is caused due to various reasons. Ever since the mid of 20th Century, scientists have been gathering information on different weather patterns and their influence upon climate. They have been continuously monitoring temperatures, precipitation levels, storms, ocean currents, etc.,

and have noted a regular change in the Earth's climate and temperature and this change have only drastically increased from the start of the Industrial Revolution.

Although there are many reasons, burning of fossil fuels, deforestation and farming are considered to be some of the main causes of global warming. Let us now look into them in detail:

4.1.1.1. Emission of Greenhouse Gases by Burning Fossil Fuels

Industrialization has had a huge impact upon the climate and the environment. Industrialization has paved way for burning of fossil fuels in a much higher level and this has led to the emission of greenhouse gases, especially hydrocarbons, whose levels are very high now than they were 650,000 years ago.

According to Josef Werne, Professor of Geology and Environmental Science at the University of Pittsburgh, "the basic physics of the greenhouse effect were figured out more than a hundred years ago by a smart guy using only a pencil and paper." The smart guy that Josef Werne refers to here was Svante Arrhenius, a Nobel Prize winner and scientist from Sweden.

In a normal scenario, the radiation from the Sun encounters the Earth's surface before moving back into the atmosphere as heat. The heat is then trapped by various atmospheric gases, which keep it from escaping into space and maintains balance so that life on Earth survives. In his 1895 paper, Svante Arrhenius observed that greenhouse gases, such as Carbon dioxide could trap heat near the Earth's surface. The increase in the concentration of these gases will make a huge difference in the amount of heat trapped in the Earth's surface which ultimately leads to global warming (Figure 4.3).

Burning of fossil fuels like coal and oil releases Carbon dioxide into the atmosphere. Australia is a big producer of Carbon dioxide when compared with the rest of the world. Observations over the last 50 years reveal that almost 100% of the increase in temperature is due to the increase in the concentration of greenhouse gases like Carbon dioxide, Methane, water vapor, etc., these greenhouse gases contribute to the greenhouse effect which we will be studying in the next section.

Greenhouse Emissions 2 Sources

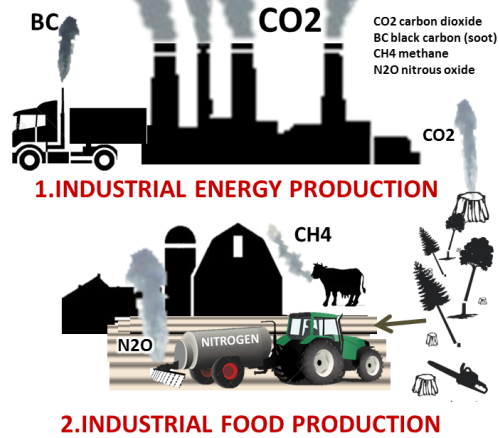


Figure 4.3: Greenhouse emission, (Source: <https://www.climateemergencyinstitute.com/greenhousegases.html>).

4.1.1.2. Deforestation

Trees and forests are powerful weapons that protect us from the negative impact of global warming. By absorbing the Carbon dioxide from the air and releasing Oxygen back into the air, plants and trees help in regulating the climate.

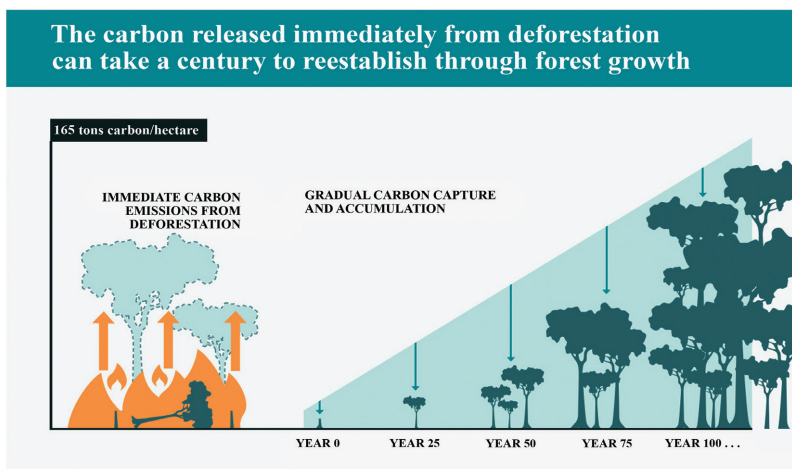


Figure 4.4: Deforestation releases carbon dioxide, (Source: <https://www.cg->

dev.org/blog/uttar-pradesh-just-planted-49-million-trees-day-shouldnt-it-get-more-guinness-world-record).

Forests and bushlands are the carbon sinks that protect this Earth from global warming. Human beings clear vast areas of forests for urbanization or for making money by selling wood, palm oil, etc., When the trees are cut or burnt, the Carbon dioxide that is stored in them is released back into the atmosphere and it adds to the global warming (Figure 4.4).

According to a research published by Duke University, deforestation is the second largest anthropogenic source of Carbon dioxide. As per Global Forest Resources Assessment for the Year 2010, deforestation releases a billion of Carbon in the atmosphere every year. Up to one-fifth of global greenhouse gas pollution comes from deforestation and forest degradation.

4.1.1.3. Farming

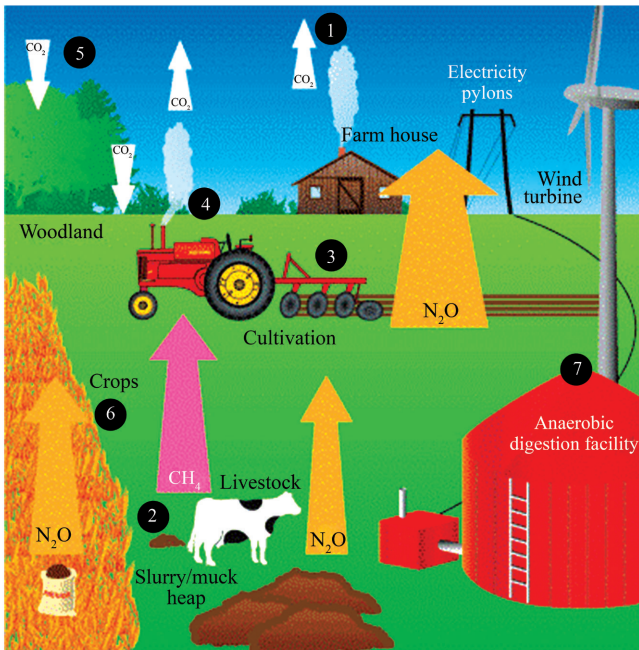


Figure 4.5: Greenhouse gas emission from farming, (Source: <https://www.gov.mb.ca/agriculture/environment/climate-change/agriculture-and-climate-change.html>).

Farming is also one of the contributors to global warming. Some fertilizers that are used in farming release Nitrous Oxide which is a greenhouse gas.

Animals, particularly livestock like sheep and cattle, produce Methane, a greenhouse gas. When livestock are grazed at a large scale, the amount of Methane produced is a big contributor to global warming.

The increase in temperature is causing the melting of glaciers, increase of sea level, burning of forests and wildlife. These are all the results of global warming and it varies from place to place. In order to support the scientific community, the Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP).

In Year 2013, the IPCC clearly reported that the global average surface temperature increased to approximately 0.9°C (1.5°F) during the period 1880 and 2012. Compared to pre-industrial era i.e., from 1750 to 1800, this increase is closer to 1.1°C (2.0°F). The IPCC also stated that most of the warming that had occurred after the second half of the 20th Century is mostly due to human activities. It is predicted that the end of 21st Century will see an increase in the global mean surface temperature from 0.3 to 5.4°C (0.5 to 9.7°F).

4.2. GREEN HOUSE GASES AND ITS EFFECTS

4.2.1. What Are Green House Gases?

Greenhouse gases are closely associated with global warming and climate change. Greenhouse gases are nothing but a group of compounds that has the ability to trap heat radiations in the Earth's surface and making it warmer. In simple words, gases that trap heat in the atmosphere are called greenhouse gases. The compounds in the greenhouse gases are made up of three or more atoms. This molecular structure allows these gases to absorb some of the heat and re-emit them back towards the Earth, which causes increase in global temperatures. These gases allows the light to pass through but keep heat from escaping similar to the glass walls of a greenhouse, hence the name 'greenhouse gases.'

Ever since the start of industrial revolution, humans have been rapidly changing the balance of gases in the atmosphere. Burning of fossil fuels like coal and oil releases some of the primary greenhouse gases like carbon dioxide, water vapor, methane, ozone and nitrous oxide (Figure 4.6).

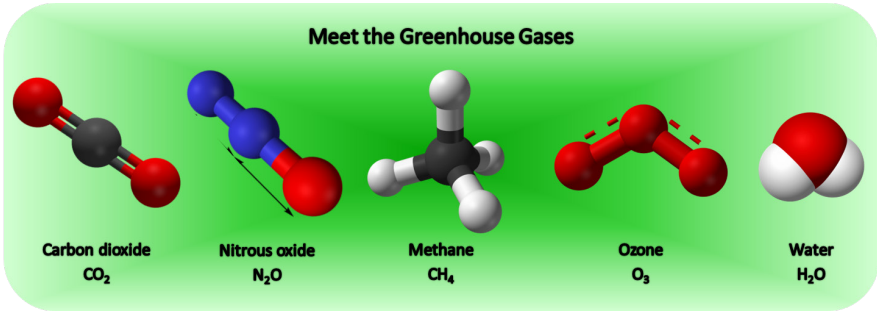


Figure 4.6: Greenhouse gases, (Source: <http://www.thesolarspark.co.uk/the-science/the-energy-crisis/global-warming/>).

Greenhouse gases are normally measured in parts per million, parts per billion and even parts per trillion. One part per million is equivalent to one drop of water diluted into about 13 gallons of liquid which is roughly the fuel tank of a compact car. The effect of each greenhouse gas is different. A Global Warming Potential (GWP) is calculated for each gas, which says for how long it remains in the atmosphere and how strongly it absorbs energy. A gas that has a higher GWP absorbs more energy per pound than gases with lower GWP.

Some important greenhouse gases are listed as below (Figure 4.7):

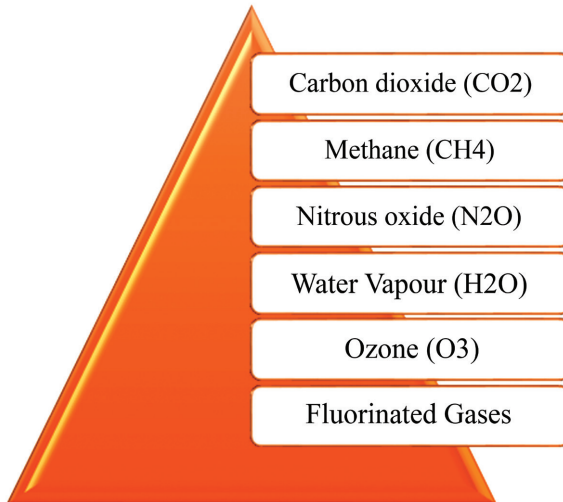


Figure 4.7: List of greenhouse gases.

4.2.1.1. Carbon dioxide (CO_2)

Carbon dioxide is the most widely known gas among all the greenhouse gases and this gas is considered to contribute significantly to global warming as this gas naturally absorbs and emits infrared radiation. Carbon dioxide is released naturally from volcanoes, groundwater, and glaciers. Carbon dioxide is not entirely harmful. Plants and trees require Carbon dioxide to perform Photosynthesis and they release Oxygen which is essential for human beings to survive. It is only when the level of Carbon dioxide increases it causes a negative impact in the atmosphere (Figure 4.8).

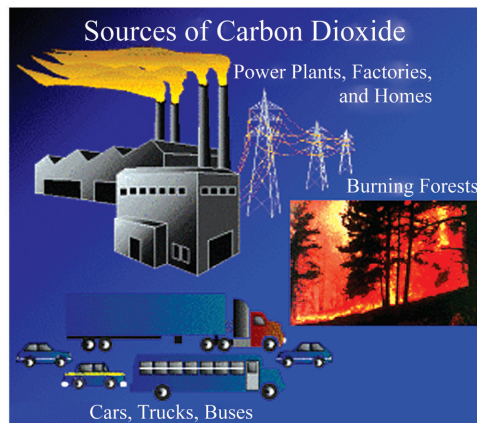


Figure 4.8: Sources of carbon dioxide, (Source: <https://www.online-sciences.com/earth-and-motion/what-are-the-sources-of-carbon-dioxide-gas/>).

Today, the increase in human activities such as burning of fossil fuels, agriculture, burning of solid waste, deforestation, and many other developmental activities contribute to the high ratio of Carbon dioxide. The concentration of CO_2 in the atmosphere today is 388,500 parts per billion which is a 108,500 increase since before industrialization. According to the Scripps Institution of Oceanography, the level of Carbon dioxide gas haven't been this high since the Pliocene epoch that occurred between 3 million and 5 million years ago.

As per an EPA inventory, Carbon dioxide formed 82% of all U.S. greenhouse gas emissions in Year 2015. Plants and trees will not be able to remove them entirely from the atmosphere when the concentration is so high. 'Carbon dioxide absorbs infrared radiation and increases the global mean temperature,' says Keith Peterman and Gregory Foy, Professors of Chemistry at York College of Pennsylvania.

4.2.1.2. Methane (CH_4)

When compared to Carbon dioxide, Methane is twenty-five times stronger considering its potential of causing global warming. Even Methane gas occurs naturally in wetlands, volcanoes, from Methane-producing insects and animals, and also as a result of human activities such as burning of fossil fuels, agriculture, raising livestock, etc., (Figure 4.9).

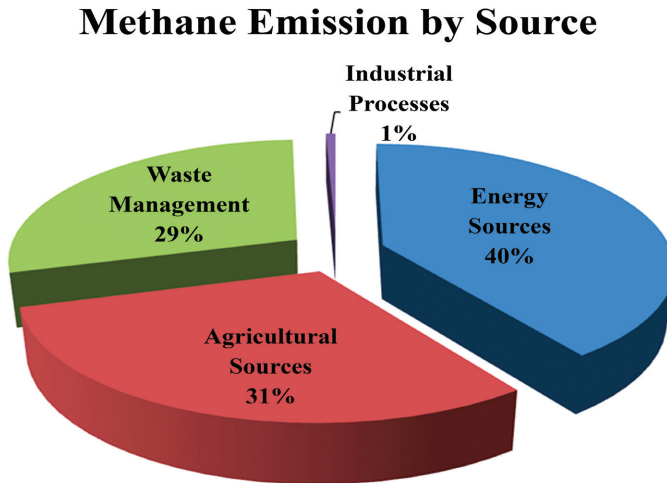


Figure 4.9: Methane emission (Source: U.S. Energy Information Association).

Earth in itself has natural sinks that helps in absorbing Methane gas but when the gas exceeds the normal level, even the Earth cannot absorb it. Unlike Carbon dioxide, Methane does not linger in the atmosphere for long period but it is eighty-four times more potent than Carbon dioxide. The lifespan of Methane gas is 12 years. The level of Methane in the atmosphere was approximately 700 parts per billion before industrialization and today it has increased to 1,870 parts per billion. As Methane gas is released both naturally and through human activities, the impact it has on the climate is huge.

4.2.1.3. Nitrous Oxide (N_2O)

Nitrous oxide is a compressed liquefied gas which has an atmospheric life of 114 years (Figure 4.10). This gas is 298 times stronger than Carbon dioxide and hence it has great potential to cause global warming. This also means that it traps heat in the Earth's atmosphere at a much higher rate than Carbon dioxide. Although Nitrous Oxide is very dangerous, it is used in several

ways such as a rocket motor oxidizer, an aerosol spray propellant, as an anesthetic and pain reliever in dentistry, childbirth, and surgery and as an internal combustion engine speed booster. Nitrous Oxide occurs naturally in the ground and it is also produced by combustion of fossil fuels, solid wastes and from agricultural fertilizers.

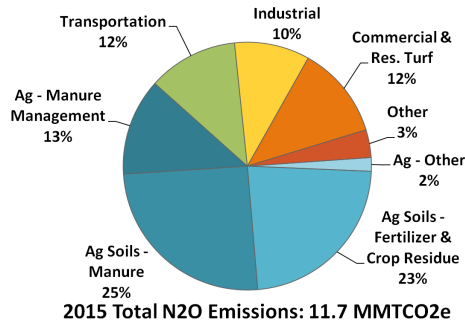


Figure 4.10: Nitrous oxide emission sources, (Source: <https://www.arb.ca.gov/cc/inventory/background/n2o.htm>).

4.2.1.4. Water Vapor (H_2O)

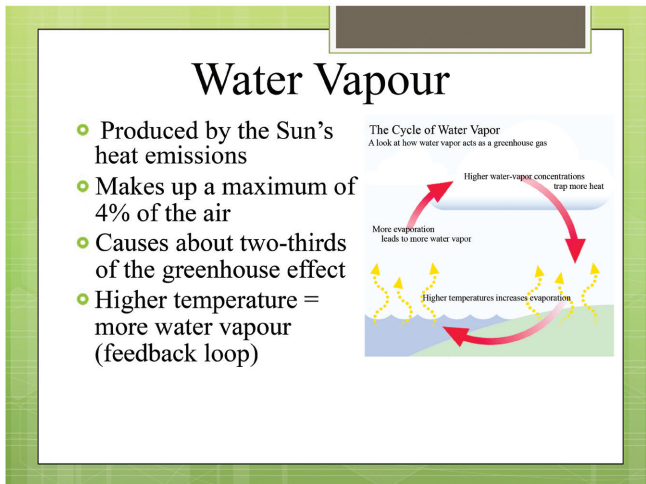


Figure 4.11: Water vapor, (Source: <https://www.slideshare.net/SabaAnwar11/greenhouse-effect-6592598>).

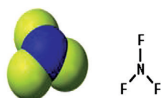
Many of us may not even have a small idea that Water Vapor has an influence on the climate. But it is true; Water Vapor is a biggest contributor to

the global climatic change (Figure 4.11). Water Vapor is not a direct product of any human activity. As the temperature increases, the evaporation also increases. This Water Vapor stays in the lower atmosphere where it absorbs the infrared radiation and pushes it further down to the Earth's surface making the already hot temperatures to rise.

4.2.1.5. Nitrogen Trifluoride (NF_3)

Nitrogen Trifluoride

- ✓ Inorganic compound with the formula NF_3 .
- ✓ Is a colorless, toxic, odorless, nonflammable gas.



prepared both by direct reaction (electric discharge) of ammonia and fluorine and

by a variation of Ruff's method (prepared nitrogen trifluoride by the electrolysis of a molten mixture of ammonium fluoride and hydrogen fluoride).

Figure 4.12: Nitrogen Trifluoride, (Source: <http://slideplayer.com/slide/982969/>).

Nitrogen Trifluoride is produced from industrial gas and from chemical companies (Figure 4.12). This gas has an atmospheric life of 550 to 740 years (Figure 4.12). The Kyoto Protocol has recognized this gas as a greenhouse gas that contributes to the global climate change.

4.2.1.6. Sulfur Hexafluoride (SF_6)

Sulfur Hexafluoride is considered to be one of the most dangerous greenhouse gases. It is an electrical insulator but generally used in the form of a liquefied compressed gas (Figure 4.13). The atmospheric life of Sulfur Hexafluoride is 3,200 years and the global warming potential of this gas is 23,900 times stronger than Carbon dioxide. It is not water soluble but dissolves in organic

solvents. Sulfur Hexafluoride is already banned as a tracer gas and is limited to high voltage applications.

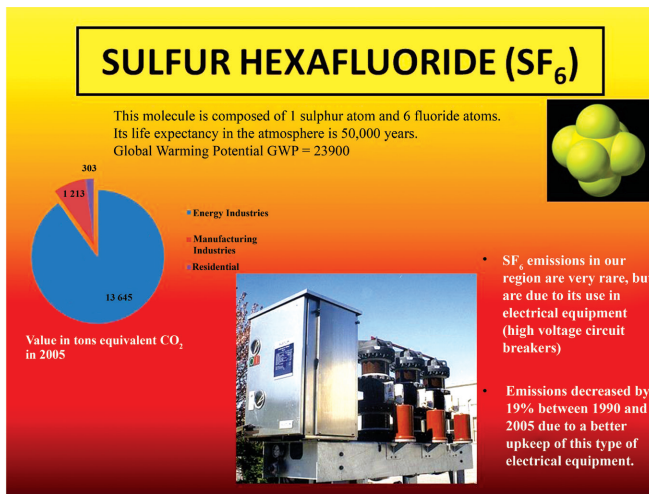


Figure 4.13: Sulfur Hexafluoride, (Source: <http://slideplayer.com/slide/1200702/>).

4.2.1.7. Hexafluoroethane (C₂F₆)

Perfluoroethane

- **Hexafluoroethane** is versatile etchant for many substrates in semiconductor manufacturing.
- Due to high energy of **C-F** bonds, hexafluoroethane is very inert and an extremely stable greenhouse gas.

Figure 4.14: Hexafluoroethane Facts, (Source: <http://slideplayer.com/slide/982969/>).

The atmospheric lifespan of Hexafluoroethane is 10,000 years and it has a global warming potential of 9,200 (Figure 4.14). This gas came into picture only after the evolution of industrialization. Hexafluoroethane is sourced from the byproducts of aluminum production processes; it is a fluorocarbon

that is used in the semiconductor industry. This gas is very dangerous as humans may get suffocated if they are exposed to high concentrations of this gas.

4.2.1.8. Tetrafluoromethane (CF₄)

Perfluoromethane

C-F bonds are strongest in **Tetrafluoromethane**.

- ✓ Prepared by the reaction of silicon carbide with F₂

$$\text{SiC} + 2 \text{F}_2 \rightarrow \text{CF}_4 + \text{Si}$$
- ✓ Reaction with F₂ and dichlorodifluoromethane or chlorotrifluoromethane
- ✓ During the electrolysis of metal fluorides MF, MF₂ using a carbon electrode.

Figure 4.15: Tetrafluoromethane, (Source: <http://slideplayer.com/slide/982969/>).

The atmospheric lifetime of Tetrafluoromethane is 50,000 years. It is considered to be one of the strongest greenhouse gases contributing to the climate change but because of its low concentration levels, currently, it is not believed to raise the temperatures (Figure 4.15). However, the concentration of Tetrafluoromethane in the atmosphere is constantly increasing and this may lead to global warming. This gas is derived as a result of using Hall-Heroult process in aluminum production. This non-flammable gas belongs to the fluorocarbon family and is also used as a refrigerant.

4.2.1.9. Chlorodifluoromethane (CHClF₂)

Chlorodifluoromethane is a significant contributor to Ozone depletion and global warming (Figure 4.16). This gas is a member of Hydrochlorofluorocarbon family and is commonly used as a propellant and refrigerant. Due to its hazardous nature, European Union has banned the manufacture of this gas and also prohibited its use in servicing refrigeration and air conditioning equipment and has only allowed the use of recycled Chlorodifluoromethane. Similar kind of phase-out strategy is followed in United States also.



Figure 4.16: Chlorodifluoromethane used as refrigerant, (Source: https://www.okorder.com/p/refrigerant-gas-r22_433648.html).

4.2.1.10. Dichlorodifluoromethane (CCl_2F_2)

(B) REFRIGERANTS

- Freon is a series of CFCs. Dichlorodifluoromethane (CCl_2F_2) is the most important one. Freons absorb heat of vaporisation on evaporation resulting in the cooling of the surroundings. they are widely used as refrigerants in refrigerators and air conditioning units.



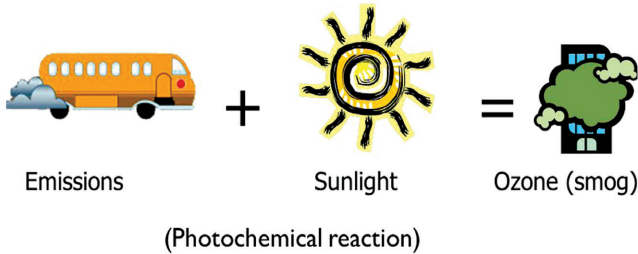
Figure 4.17: Dichlorodifluoromethane used as refrigerant, (Source: <http://slideplayer.com/slide/3844676/>).

Dichlorodifluoromethane, most commonly known as Freon-12 has an atmospheric life of 102 years and it is finally degraded by solar radiation (Figure 4.17). However, its degradation gives it the ability to destroy the Ozone layer causing the Sun's ultraviolet rays to enter the Earth's atmosphere. Due to its devastating effects on the Ozone layer and as per Montreal Protocol, manufacturing of Dichlorodifluoromethane gas has been

made illegal. However, it is still permitted to be used in aerosol spray cans, on submarines, and as a refrigerant.

4.2.1.11. Ozone (O_3)

Ozone (O_3) (Smog)



Ozone - good up high, bad nearby

Figure 4.18: Ozone, (Source: <http://slideplayer.com/slide/5667110/>).

Ozone gas is produced from human interventions such as chemical solvent plants, industrial plants, and burning of fossil fuels (Figure 4.18). Ozone gas can be seen in two forms – Stratospheric and Tropospheric. Stratospheric is a natural one whereas Tropospheric Ozone gas is considered to be a greenhouse gas that contributes to climate change. Prior to the emergence of industrialization, the concentration of Tropospheric Ozone in the atmosphere was 25 parts per billion but today it is approximately 34 parts per billion. Ozone also causes smog when it mixes with Carbon monoxide.

Greenhouse gases are not essentially a bad thing. But the increase in the concentration of these gases affects the temperature of the Earth. Without these gases, the average surface temperature would have been much cooler than what it is now. We saw that among the greenhouse gases, Carbon dioxide, Methane and Nitrous Oxide are produced through both natural processes and human activities whereas most of the fluorinated gases are emitted exclusively through human activities. Because of their high potent, these fluorinated gases are sometimes referred to as ‘High Global Warming Potential gases or High GWP gases.’ The industrial revolution which began in the 18th century has led to the growth of these dangerous gases and so the concentration of these gases is now controlled by humans directly. The more

the greenhouse gases stays in the atmosphere, the more Earth gets heated (Figure 5.19).

Global human sourced GHG emissions by sector

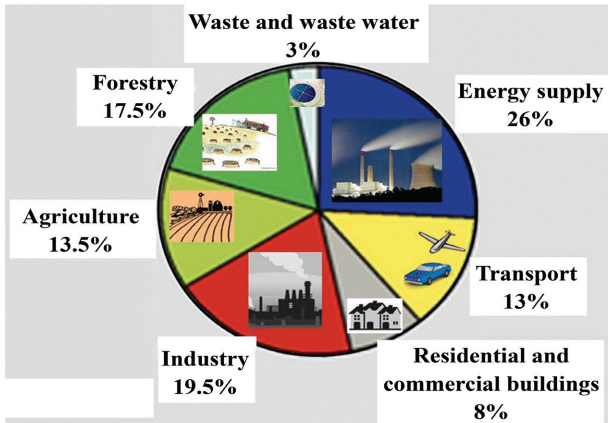


Figure 4.19: Global human sourced GHG emissions by sector, (Source: http://www.climate-change-knowledge.org/ghg_sources.html).

All these greenhouse gases mix up in the atmosphere and they do not leave very easily like water which condenses to become rain or snow. They stay in the atmosphere for many years and do not react to any changes in the temperature or air pressure. The increase in the greenhouse gases causes greenhouse effect which creates global warming and ultimately leading to climate change.

4.2.2. Green House Effect

In a normal scenario, when sunlight reaches Earth's surface, some of it is absorbed and most of them is radiated back to the atmosphere. When greenhouse gases are present in the atmosphere, they absorb some of the heat rays before they are completely lost in space. This heat up the atmosphere and these greenhouse gases reflects them back to Earth and so the Earth would receive heat rays again which would otherwise be lost in space if greenhouse gases does not exist. This reflecting back of heat energy by the atmosphere is known to be 'the greenhouse effect' (Figure 4.20).

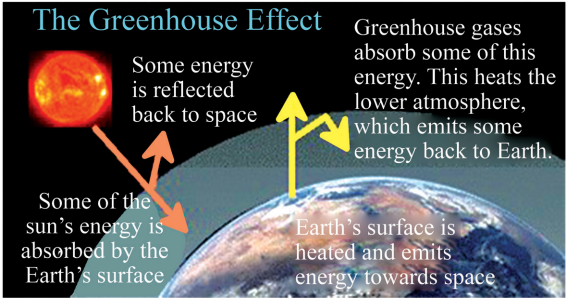


Figure 4.20: The greenhouse effect, (Source: http://ete.cet.edu/gcc/?/volcanoes_greenhouse/).

Out of the many greenhouse gases, Water Vapor is said to cause about 36–70% of the greenhouse effect; Carbon dioxide’s effect is 9–26%; the greenhouse effect of Methane is 4–9% and Ozone causes 3–7%. The greenhouse effect of any gas is determined by two of its characteristics:

- Global Warming Potential (GWP).
- Atmospheric Lifetime.

Global Warming Potential (GWP) as seen earlier, is the effect of each unit of gas over a specified period of time expressed relative to the effect of Carbon dioxide.

Atmospheric Lifetime is the length of stay of any gas in the atmosphere before any natural processes removes it.

The GWP and the atmospheric lifetime values are periodically updated by the scientific community. The below table represents the GWP and atmospheric lifetime values for some of the greenhouse gases (Figure 4.21):

	Global Warming Potential (100 Year Time Horizon)	Atmospheric Lifetime (In Years)
Carbon dioxide (CO ₂)	1	100
Methane (CH ₄)	25	12
Nitrous Oxide (N ₂ O)	298	114
Chlorofluorocarbon -12 (CFC12)	10,900	100
Hydrofluorocarbon – 23 (HFC23)	14,800	270

Sulfur Hexafluoride (SF ₆)	22,800	3,200
Nitrogen Trifluoride (NF ₃)	17,200	740

Figure 4.21: GWP and atmospheric lifetime values of greenhouse gases, (Source: *Fourth Assessment Report (Intergovernmental Panel on Climate Change IPCC, 2007)*).

Scientists were aware of the greenhouse effect much earlier, i.e., since 1824 when Joseph Fourier predicted that the Earth must have been much cooler if there was no atmosphere. The Swedish chemist Svante Arrhenius discovered in 1895, that the humans would enhance the greenhouse effect by producing more Carbon dioxide. The knowledge shared by Svante that day made everyone understand the concept of global warming. The concentration of Carbon dioxide and the average global temperature have been fluctuating for hundreds of thousands of years depending upon the position of Earth to Sun. Ice ages have come and gone as a result of these fluctuations.

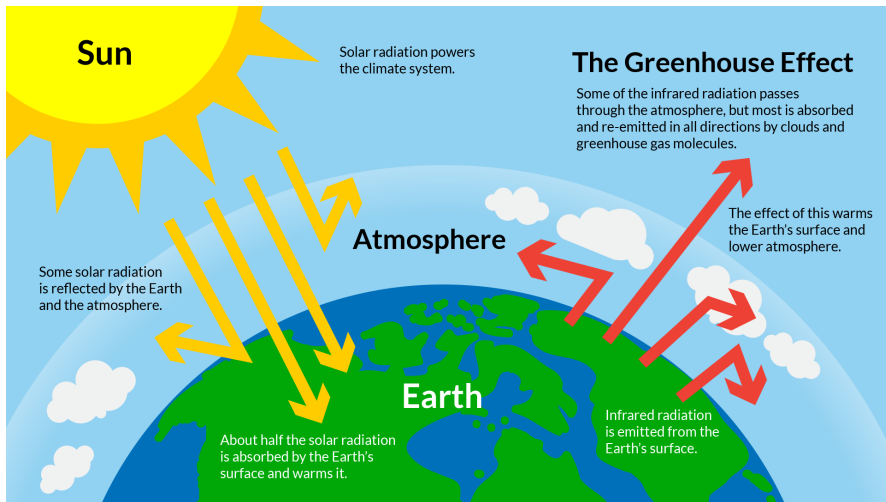


Figure 4.22: The greenhouse effect, (Source: <http://www.klebenhouse.com/greenhouse-effect/6/pin-greenhouse-effect-diagram-1-on-pinterest/>).

For the past thousands of years, the greenhouse gas emissions in the atmosphere have been balanced by the greenhouse gases that are absorbed naturally. Hence the temperature has not become a serious cause of concern so far and has allowed humans to survive and develop their civilization.

Increase in the magnitude of the greenhouse effect has resulted in global warming. The conditions may not be the same always.

4.3. HOW DOES GLOBAL WARMING IMPACT THE WORLD?

Global Warming impacts the world in different ways – increase in the global temperatures is one of the primary effects of global warming. Global Warming leads to what is called climate change. Increase in the greenhouse gases is causing the climate to change at a faster rate which is very difficult for the living species to adopt. The unpredictable change in climate poses ‘n’ number of challenges to the living world.

As the greenhouse gas level increases, the ice sheets of the Earth, such in Antarctica, Arctic and Greenland have started to melt which increases the sea level. Sea levels are also increasing due to thermal expansion of oceans. Global warming and the climate change do not stop with increase in sea level alone; the weather becomes more extreme; there are intense storms, heavy downpours as well as droughts which makes it hard for the crops to grow (Figure 4.23).

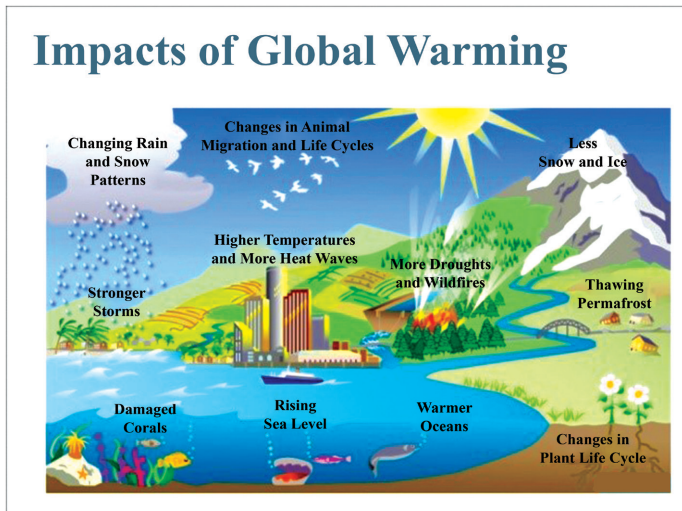


Figure 4.23: Impacts of global warming, (Source: <https://www.slideshare.net/jagchat01/climate-change-impacts-on-coastal-odisha>).

These are the many extreme ways by which climate change caused by global warming will affect the world. Many more changes are anticipated. For example, the Southwest and Central Plains of the United States are expected to face ‘megadroughts’ that may last for many years. Benjamin Cook, a Climate Scientist at NASA’s Goddard Institute for Space Studies in New York City has told Live Science that, “The future of drought in Western North America is likely to be worse than anybody has experienced in the history of the United States. These are droughts that are so far beyond our contemporary experience that they are almost impossible to even think about.” As per the study conducted by him, there is an 85% chance of droughts lasting for at least 35 years in the region by 2100.

Right from human beings to plants and animals, everything will be affected by global warming. In fact, most of the plant and animal species are already on the verge of extinction. According to some studies, 15–37% of the plants and animals will become extinct by year 2050. It is very evident from all the happenings that the Earth has already started to face the consequences of global warming. Due to warm climate, many areas will see less rainfall. A research study conducted in 2014 has found that sub-tropical regions including the Amazon, the Mediterranean, Central America and Indonesia will face the hardest hit while Mexico, South Africa, Western Australia and California will also dry out.

As the planet warms, hurricanes and typhoons are expected to occur more often. This is because the oceans evaporate more moisture and these intensify these storms when it becomes hot. It has been felt that there has been a high correlation of hurricane power with tropical sea-surface temperature. As per the prediction of The International Panel on Climate Change (IPCC), even if the planet diversifies its energy sources and transitions to a less fossil-fuel intense economy which is known as the A1B scenario, tropical cyclones are likely to be up to 11% more intense on average. This means global warming will bring in more wind and water damage on vulnerable coastlines. Extreme snowstorms are also one of the effects. According to the National Centers for Environmental Information, extreme snowstorms in the Eastern United States have become twice as common since the early 1900s.

Ocean disruption is one of the immediate impacts of global warming. The oceans acts as a Carbon sink and absorb the Carbon dioxide from the atmosphere. Although this is good for the atmosphere, it is not a good thing for the marine ecosystem. Carbon dioxide reduces the pH level in seawater

and this is called as ocean acidification. Increased acidity eats away all the calcium carbonate shells and skeletons that many ocean organisms depend upon for survival. High temperature in oceans leads to coral bleaching. Australia's Great Barrier Reef is a perfect example for the worst coral bleaching that is happening in the world.

Precipitation patterns are changing. Frequency of heat waves and tornadoes are likely to increase. Apart from these, there will be ups and downs in the agricultural yields, extinction of species and many diseases which were eradicated earlier in certain regions are returning. The biggest threat for most of the cities is increase in sea-level. According to the Scientists working at Climate Central, a non-profit organization, approximately 275 million people living worldwide reside in areas that are most likely to be flooded if global warming temperature reaches 3°C. The United Nations has already warned the world leaders that we are now on course for 3°C of global warming.

Let us now see the predictions of some of the nations which are expected to get impacted due to global:

4.3.1. Osaka in Japan

Japan is already facing the threats of global warming induced climate change (Figure 4.24). The GDP of Osaka is almost as big as that of the Netherlands and studies reveal that such a big city will disappear under water if global warming reaches 3°C.



Figure 4.24: Coastal flooding risk in Osaka due to global warming, (Source: https://media.spokesman.com/photos/2018/09/04/Japan_Asia_Storm.JPG.jpg).

This is a great threat to over 19 million residents who live in the urban areas surrounding Osaka. As per the statement issued by the Union of Concerned Scientists, increase in sea level, storms and other factors may cause coastal flooding which could put almost \$1 tn of Osaka's assets at risk by Year 2070. The money that needs to be allocated for protecting the city from rising sea levels and storms will also increase.

4.3.2. Cities of Asia



Figure 4.25: Flooding in China, (Source: <http://www.climatesignals.org/headlines/events/china-floods-june-july-2016>).

In Asia, it is predicted that at least four out of five people will be affected due to the impacts of global warming (Figure 4.25). The threat of sea level increase is always on the cards for the Asian cities and there will not be much harm until the temperature rise hits 3°C.

4.3.3. Alexandria in Egypt



Figure 4.26: Flooding in Alexandria, (Source: <http://www.ecotv.com>).

ng/2017/11/03/osaka-japan-top-as-the-cities-that-will-be-drowned-by-global-warming/).

The coastline of Alexandria that attracts the locals as well as tourists with its beauty also gives fear among people due to the rise in sea level caused by global warming (Figure 4.26). As per the reports from IPCC, the beaches of Alexandria would submerge even if the sea level rises another 0.5 meter high and if no preventive measures are taken, 8 million people would be displaced by flooding in Alexandria and the Nile Delta. If this is the case, the impact of 3°C world is hard to even imagine. Alexandria is ranked as the second as the cities that will be drowned by global warming.

4.3.4. Shanghai in China



Figure 4.27: Picture representing flood threat in Shanghai, (Source: http://www.timeoutshanghai.com/features/Blog-Shanghai_news/31246/Shanghai-will-be-underwater-by-2100-if-climate-change-continues.html).

A report received from a team of UK and Dutch scientists in 2012 has declared Shanghai to be the most vulnerable major city in the world to be impacted by serious flooding. According to Climate Central projections, 17.5 million people could be displaced by rising waters if global temperatures increase by 3°C. The former fishing village Shanghai is bordered by the Yangtze River in the north and divided through the middle by the Huangpu River; the municipality involves several islands, two long coastlines, shipping ports, and miles of canals, rivers, and waterways. It is projected that majority of the city could eventually be submerged in water including landmarks such as the Lujiazui skyline and the historical Bund, both airports, and the outlying Chongming Island.

4.3.5. Miami in US



Figure 4.28: Miami after hurricane Wilma in year 2005, (Source: <https://www.rollingstone.com/politics/news/why-the-city-of-miami-is-doomed-to-drown-20130620>).

With every successive ‘king tide,’ we can see knee-deep sea water running through the streets of coastal Miami. This has become quite normal in the big city of Florida. Forecasts show that almost the entire bottom third of Florida – the area which is South of Lake Okeechobee which is currently holding more than 7 million people will get submerged in water even if the rise in temperature hits 2°C. It is calculated that almost \$15bn of coastal property is at the risk of flooding shortly within next 15 years in Miami-Dade County alone.

4.3.6. Rio de Janeiro in Brazil

Although not knowing much about the impacts of global warming, the residents of Rio de Janeiro fear a lot about it for various reasons. Climate Central has stated that, if the temperature rises to 3°C, it would not stop with flooding of famous beaches like Copacabana and its waterfront domestic airport but the flooding will also damage the inland areas of the Barra de Tijuca neighborhood, where the Olympic Games were held (Figure 4.29).

Rio has already started to face the impacts. Few hundred meters of beachfront pavement overlooking the popular surfing spot Macumba beach located on the western fringes of Rio has been destroyed by storm surges. Recently another storm surge felled an elevated, cliff top cycle path between Leblon beach and Barra de Tijuca which had not been built to survive such high seas, killing two people. Sea level rise would cost a lot of jobs also.



Figure 4.29: Ipanema beach, Rio de Janeiro, (Source: <http://observer.com/2016/03/now-is-a-good-time-to-start-caring-about-the-zika-virus/>).

Not only the nations face destruction in their landscapes but their economy is also going to get affected. The nations that depend on agriculture as their main source of income will face huge economic loss as the floods and droughts may ruin cultivation and crops may fail. The countries that depend on tourism as their main source of income generator will also face similar kind of problem. Increase in sea level will take off all the coastal areas and there will no longer be any beautiful beaches for tourists to hang out. Maldives is a perfect example for this. Also in today's world, a slight change in the economy of one country will impact other countries as well; so the global warming will surely have impact on the global economy.

Even though there are quite a few positive outcomes of global warming, the research suggests that the negative impacts outweigh the positive impacts. As we know, green-house gases stays in the atmosphere for a longer period and hence our planet will continue to see the changes caused by it unless we do something to reduce the emission of these gases. We will look into more ways to reduce global warming in the last section of this Chapter.

4.4 GLOBAL WARMING AND TOURISM

Global Warming has a major impact on the tourism industry. Due to the rise in temperatures, regions that are currently hot will become too toasty and the places that are currently chill will become warm. Global Warming certainly has very interesting effects on the tourism industry. There will be a total shift. Research scholars Andrea Bigano of the Fondazione Eni Enrico Mattei in Milan, Italy, Jacqueline M. Hamilton of Hamburg University and Richard S.J. Tol of the Economic and Social Research Institute in Dublin claim that, "Climate change would shift patterns of tourism towards higher altitudes and latitudes. Tourism may double in colder countries and fall by 20% in warmer countries. For some countries, international tourism may treble whereas for

others it may be cut in half.” These researchers made use of a mathematical simulation model developed by Hamburg University researchers to predict tourist flows to and from 207 countries, based on characteristics known to affect leisure travel. Some of the factors are population growth, temperature, and the economy. Then they plugged in estimates that global warming will cause the world’s temperature to rise about 3°C by 2100, or about 5°F, to see its effect on tourism.

Their research showed that United States could be one of the tourism winners with the arrival of international tourists to U.S. spiking to 13.7% over what it would have been if the atmosphere wasn’t warming up. Canada is also predicted to have a 220% increase in international arrivals by 2100, Russia by 174% and Mongolia by 122%. Some countries will also see a decline in the number of tourists. Let us see the predicted increase and decrease percent of tourists in some countries due to global warming (Figures 4.30 and 4.31):

Country	Increase % in Tourism
Canada	220
Russia	174
Mongolia	122
Kyrgyzstan	89
Zimbabwe	88
Tajikistan	86
Iceland	85
Finland	82
Zambia	82
Norway	77

Figure 4.30: Projected increase percentage in tourism due to global warming, (Source: Richard S.J. Tol).

Country	Decrease % in Tourism
Mauritania	60
Mali	59
Bahrain	58
Qatar	58
Kuwait	56
United Arab Emirates	55

Senegal	54
Niger	54
Burkina Faso	53
Namibia	52

Figure 4.31: Projected decrease percentage in tourism due to global warming, (Source: Richard S.J. Tol).

The increase in temperature will make countries like Canada and other European countries more habitable than now and so will attract more tourists. Some countries will face the consequences of droughts and will become more similar to a desert. A shift in the tourism industry also means a shift in the resources. Countries in the North will have to shift more resources from other industries to cater to their booming tourism industry, whereas countries in the Caribbean and Mediterranean will have to adapt to the new situation and shift resources from the now declining tourism industry to other more profitable industries.

Many countries are developing their tourism business in a fastest way. Turkey is one such example. The number of tourists visiting Turkey has increased since 2000 and the number has exceeded 27 million in 2009. The tourism revenue of Turkey has crossed over 16 billion dollars. Not only tourism but a number of other sectors connected with tourism such as transportation, food and construction industry will also get affected even if there is a slight change in the temperature. Places that are famous for some tourist activities may no longer be suitable to carry out such activities. For example, Skiing is one such activity. Many places that were famous for skiing once, no longer attracts tourists and new areas are becoming more adaptable for it (Figure 4.32).



Figure 4.32: Global warming threatens winter sports, (Source: <http://www.cli->

matecentral.org/gallery/graphics/global-warming-threatens-winter-sports).

Global Warming is one of the crucial problems that the world is facing now and out of the many industries that are affected, tourism is the most impacted one.

4.5. END GLOBAL WARMING AND SAVE EARTH

As many of the nations have already faced the bad effects of global warming, leaders across the world, citizens are all very much concerned over the issue and are ready to do anything to stop global warming from occurring. The reports released from the International Energy Agency and the UN Environment Programme (UNEP) brings panic among all by stating that, we have blown off all our chances of counteracting the effects of climate change. But some believe that still there is a little chance to undo the damage and also protect our planet Earth. As we all know, it is not as easy as it is said (Figure 4.33).



Figure 4.33: Picture representing global warming effects, (Source: <http://honorbiology-globalwarming.blogspot.in/2012/10/help-stop-global-warming-would-you-wan.html>).

There is no single solution to stop global warming which means one single change cannot stop the entire process. Every individual has to contribute productively from their end to support the cause. What the human beings have caused to the nature must be removed only by them. If we leave it to nature, it may clean up the mess, but we will have to pay for it. The

greenhouse gases are sighted as the main root cause for global warming. But even if the emission of these gases is stopped, the Earth may still warm up by one degree Fahrenheit or so; still, it will make a difference. Scientists predict that the Earth could eventually warm by as little as 2.5 degrees or as much as 10 degrees Fahrenheit depending upon the choices that we make.

Stabilizing greenhouse gas concentration levels to 450–550 parts per million or about twice pre-industrial levels should be the common goal because if this can be maintained, then the most damaging impacts of climate change can be avoided. With the current concentration of GHG being 380 ppm, there is not much time left to think. IPCC suggests that if we reduce the greenhouse gas emissions by 50–80% of what they are in the next century, then, these levels can be reached.

People are innovating and working on various ways to reduce the greenhouse gas emissions. Researchers Stephen Pacala and Robert Socolow at Princeton University have suggested one approach that they call “stabilization wedges.” Using this technique, greenhouse gas emissions can be reduced from a variety of sources with the technologies available in the next few decades, rather than relying on an enormous change in a single area.

They suggest seven wedges that could each reduce emissions. All of them together could hold emissions at approximately current levels for the next 50 years, putting us on a potential path to stabilize around 500 ppm. Many such wedges will be created which will not only limit itself to reduction in GHG gases but will also improve energy efficiency. Another possibility is on the cards which is named ‘carbon sequestration’ through which the carbon dioxide emitted from fossil fuels are captured and stored underground.

United Nations has set a goal of limiting global warming to just 2°C. Accomplishing this may not be an easy task by just following one method. Few say that we might have already missed the goal. As we work on the reducing the emissions, we can also think about increasing the amount of gases that we take out of the atmosphere. Plants and trees are the best tools to suck Carbon dioxide from the atmosphere. The more trees we grow, the more amount of Carbon dioxide can be removed from the atmosphere (Figure 4.34).

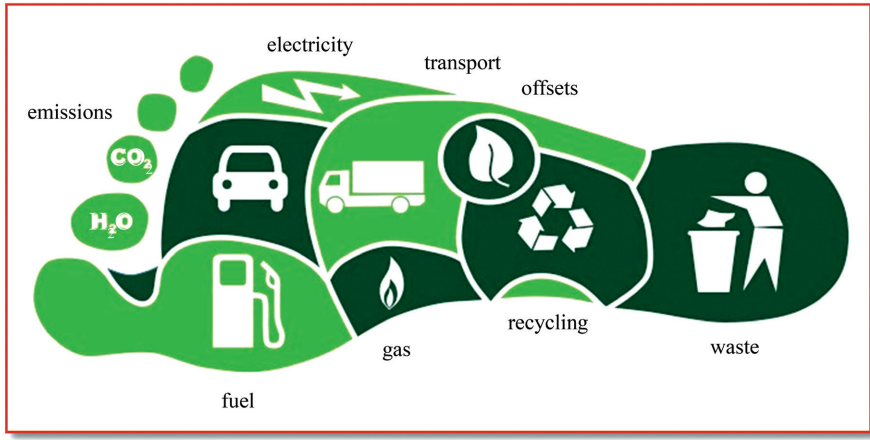


Figure 4.34: Reducing Carbon Footprint, (Source: <http://www.insolergy.com/blog/solar-adoption/solar-can-reduce-your-carbon-footprint/>).

In order to achieve UNs goal of 2°C, every single nation has to reduce their emissions no greater than 44 gigatons by 2020. But with the industrial development happening across Africa and East Asia, this amount of reduction is simply out of question. Despite many international efforts like the Kyoto Protocol and the UN Framework Convention on Climate Change (UNFCCC), the emission of Carbon dioxide is still on the increase. Even if these agreements were implemented fully across the globe, climatologists feel that we would still have a 3.5% rise in atmospheric temperatures by 2100.

UNEP has put in a plan to cut the crap that's giving us short-term trouble and to provide world governments enough time to pull their collective heads together and enact effective legislation to significantly reduce CO₂ emissions, which are the real problem but take a long time to fix. The plan laid out by UNEP calls for 16 measures targeting both short and long-term climate forcers that, if universally enacted, could save up to 2.5 million, 32 million tons of crops, and reduce the rate of global warming by half a degree Celsius by 2040. All these 16 measures have already been locally enacted by various world governments with varied levels of success and target black carbon, methane, and ozone production (Figure 4.35).



Figure 4.35: Stop global warming to stop these from happening, (Source: <https://www.slideshare.net/RohiniArumugam/save-the-earth-presentation>).

Implementation of recovery of Methane from coal, oil, and gas extraction for use as fuel, banning the field burning of agricultural waste, and distribution of clean-burning cooking stoves and kilns in developing nations is one of the measures taken by UNEP. Usage of Liquefied Petroleum Gas or biogas stoves throughout Africa, Asia, and Latin America instead of traditional biomass cookstoves would help with a 25% reduction which is necessary to reach the 2°C goal. The users are also benefited as they have to spend very less on fuel cost. Similarly, replacing traditional kilns with Vertical-shaft brick kilns (which are twice as efficient) would cut back on CO₂ while costing half as much to run.

Global Warming is going to cause a lot of pain and more damage to the ecosystems, weather patterns, and many others. We all have equal responsibility in giving a better world to our future generations; failing to do so is a great shame.

Below given suggestions are some of the practical ways by which we can stop or prevent global warming from happening:

Aliya Haq, Deputy Director of NRDC's Clean Power Plan initiative says, "Change only happens when individuals take action. There's no other way, if it doesn't start with people."

- By buying eco-friendly products we are not only doing justice for us

but also for the Universe. The trend of purchasing eco-friendly products is increasing day by day and this is a good sign for reducing global warming. Using appliances with energy star label will help lessen the amount of energy wasted in your home. We should try as many ways as possible to go green (Figure 4.36).



Figure 4.36: Buy eco-friendly products to stop global warming, (Source: <https://www.pinterest.co.uk/bosinver/plastic-ocean-the-final-straw/>).

- Recycling and reusing products will help to cut short plastic usage. Reusing and recycling old items can significantly reduce the carbon footprint as it takes far less energy to recycle old items than to produce items from scratch. We have to consciously purchase reusable water bottles, yogurt cups, bread ties and other such items. We have to create a simple rule as not to throw away stuff. Whenever we reuse products, we are saving on dumping waste (Figure 4.37).

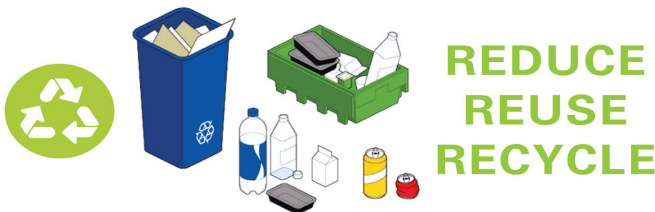


Figure 4.37: Recycling and reusing products to stop global warming, (Source: <https://rubbishbegone.co.uk/blog/climate-change-united-kingdom/>).

Have we ever thought of reducing waste? How can we reduce waste? Be smart to not buy products with lot of packaging as we end up throwing the waste materials in the garbage which will help in filling landfill sites and pollute the environment. Also, spread the message and discourage anyone from doing so. Try to recycle anything possible. For example- papers, cans, aluminum foils, etc., can be recycled. The more we recycle, the more we help in reducing landfills. When the garbage is burnt, it releases toxic gases in the atmosphere which results in global warming.

- As an individual, we can help in reducing carbon emissions by driving less. Carpooling is a great option. By combining trips with our colleagues and friends, we are not only cutting down on the fuel emissions but also strengthen our relationships. It is always better to walk or use bicycle to nearby places; it serves as a great exercise for our body. Smart cars, Electric Cars, Cars that run on vegetable oils, etc., are all great examples for using renewable energy. If electric car is not affordable, we can also buy the cleanest gasoline possible. Oil and gasoline are the biggest polluting agents and cutting down on their consumption is a huge step in reducing energy wastes. When we consume less, the less carbon dioxide is released into the atmosphere (Figure 4.38).

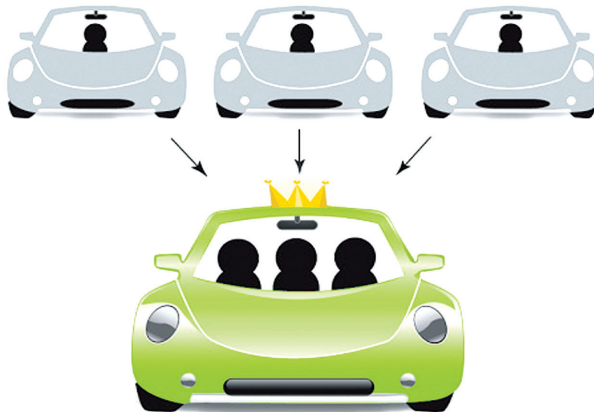


Figure 4.38: Try carpooling to stop global warming, (Source: <https://theecoguide.org/many-benefits-car-sharing-and-carpooling>).

- While driving, make sure that the tires are inflated properly. If not, the vehicle might consume more fuel which in turn releases

more Carbon dioxide in the atmosphere.

- We can even save energy consumption by using Compact Fluorescent Light (CFL) bulbs instead of regular incandescent light bulb. More simple way is to turn off the lights when not used. Not only light, any electrical appliances need to be turned off if not in use. We know that electricity is generated by burning coal and this emits gas. By reducing the use of electrical appliances, we not only reduce gas emissions but also increase the lifetime of gadgets. Buying energy saving geysers and dishwasher for homes is also a good option to save energy. Reduce the use of hot water as it will save energy that is required to produce hot water (Figure 4.39).

Switch to energy-efficient lighting

- Replace the familiar incandescent light bulbs with compact fluorescent bulbs (CFL).
- CFL bulbs last much longer and use only a quarter of the energy consumed by conventional bulbs.
- For each CFL bulb replacement, you'll keep nearly 700 pounds of carbon dioxide out of the air over the bulb's lifetime and lower your energy bill.



Compact Fluorescent Lamps (CFL).

Figure 4.39: Use compact fluorescent light (CFL) bulbs to stop global warming, (Source: <https://www.slideshare.net/Busqueda/how-to-slow-global-warming-part-i>).

- Making use of solar energy is something that has caught everyone's attention now and it is a great initiative to reduce fuel consumption. Installing solar panels is very easy; it is readily available and very much possible in today's world. In order to promote the usage of solar panels, government agencies and energy companies have announced many incentives and discounts (Figure 4.40).

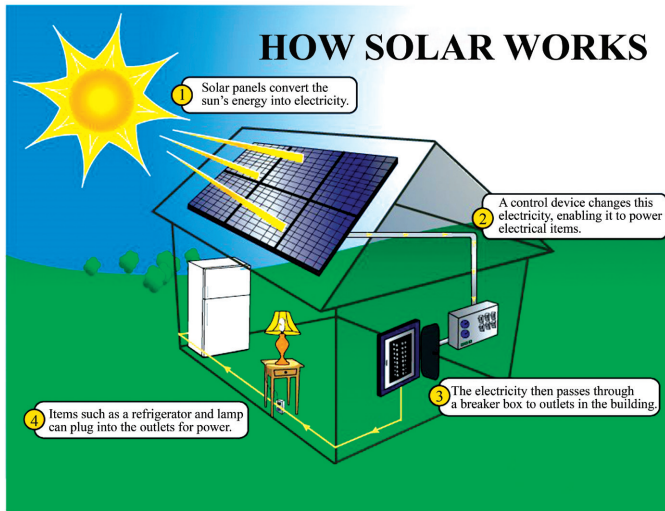


Figure 4.40: Install solar panels to stop global warming, (Source: <https://le-rablog.org/technology/green-tech/advantages-and-disadvantages-of-solar-panels/>).

- Many are even thinking of installing a Programmable Thermostat. It is very cost efficient and even the cost taken to buy it can be recovered from the amount that can be saved by reducing energy. It is always wise to buy energy efficient products since it saves good amount of money on the energy bill, save energy and most importantly helps in reducing carbon footprint (Figure 4.41).

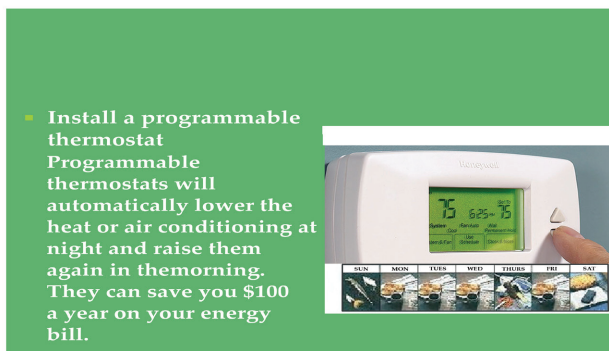


Figure 4.41: Install programmable thermostat to stop global warming, (Source: <https://www.slideshare.net/tranceking/an-inconvenient-truth-things-to-stop-global-warming>).

- Methane is also one of the greenhouse gases that contribute significantly to global warming. Consumption of meat increases the emission of Carbon dioxide as the amount of cows breathing out methane is increasing. This is a point that needs attention but nothing much can be done about it now.
- Some habits that we follow in our day today lives also cause global warming. Most of us lead our life in a way that, we take everything for granted. The amount of water wasted by millions of Americans for brushing their teeth can be utilized by 23 nations. Practice to take showers instead of baths as showers use less water than baths by 25%. We can save hundreds of gallons of water by doing this and also it is a known fact that huge energy is required to draw and filter water from underground (Figure 4.42).



Figure 4.42: Use cloth instead of paper towels to stop global warming, (Source: <https://www.slideshare.net/AllahDadKhan/ways-to-stop-global-warming-by-allah-dad-khan-peshawar>).

Do not neglect our age-old practices. Dryer is not the only option to dry our clothes. Minimize the usage of dryer. Using a kitchen cloth in the place of paper towels will definitely reduce the cutting down of trees and factory pollution. Avoid processed foods as it will cut down the costs used by factories to produce processed foods.

- Wrap your water heater in an insulation cover. By keeping the energy in the water heater condensed, less energy is emitted into the air. This not only helps the earth but your pocketbook also (Figure 4.43).

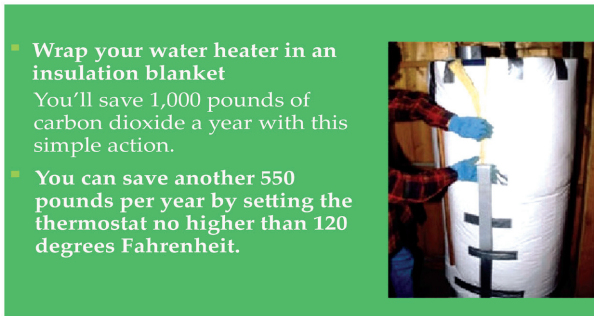


Figure 4.43: Wrap water heater in insulation to stop global warming, (Source: <https://www.slideshare.net/tranceking/an-inconvenient-truth-things-to-stop-global-warming>).

- The best and most efficient way to reduce global warming is by planting more trees. Trees help humans by releasing Oxygen and also by taking in Carbon dioxide which is the main source of global warming (Figure 4.44).

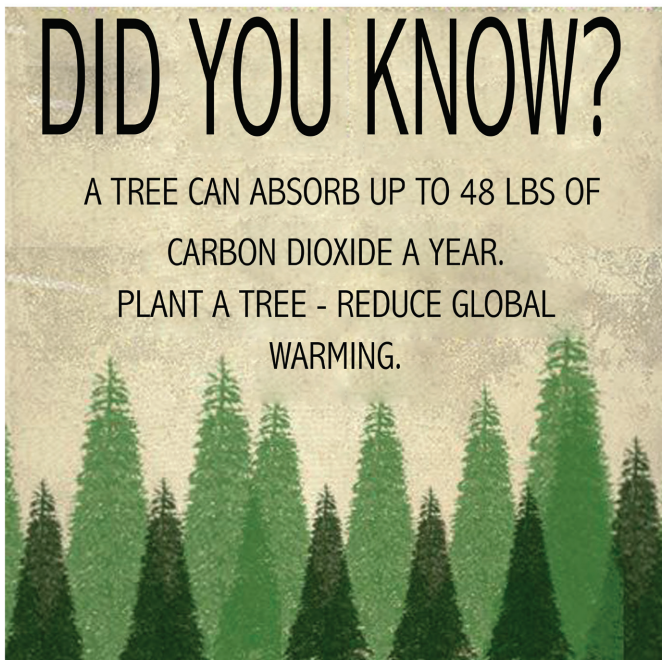


Figure 4.44: Plant trees to stop global warming, (Source: <https://in.pinterest.com/connect4climate/climate-inspiring-quotes/>).

These are some of the ways by which every individual can contribute to the reduction of global warming and climate change. If we are not sure of the amount of energy we spend, we can get an audit done to our home with the help of a home energy audit company. After all with the technology in our fingertips, we need to know how much of Carbon dioxide we emit. This will help us in identifying areas that consume lot of energy and are not energy efficient at all. By becoming a member of The Climate Change National Forum and Global Humanitarian Forum, we would easily get to know the latest statistics on global warming.

We can also educate more people about global warming and motivate them to act against it. Only we human beings have the ability to prevent global warming from taking a big picture. The world is in our hands and we have to save it in order to save ourselves and the future generations.

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CHAPTER 5

DISAPPEARING TOURIST DESTINATIONS: A NEGATIVE IMPACT OF CLIMATE CHANGE

“We are facing a tipping point of environmental crisis unprecedented in human history and our very survival is dependent on protecting nature.”
—Leonardo DiCaprio

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Tourism is one of the big and growing industries that is under great threat due to the climate changes that is happening throughout the world. Both tourists as well as the tourism business face disappointment due to the altering weather conditions. The length of stay of the tourists reduces when they don't receive what they expected. Many tourists activities and sports events gets cancelled due to unprecedented changes in weather and this results in loss not only to the tourism industry but also to all the other ancillary industries that depend upon tourism for their livelihood. In this Chapter, we are going to learn the negative impacts of climate change on tourists as well as the tourism business. We will also learn about the impact of climate change on various tourist destinations and understand how the governments and environmentalists are working to avoid further damage. The last part of the chapter will specifically focus on the various tourist destinations that are on the verge of disappearing from this planet if the climate change continues.

5.1. CHANGE IN WEATHER DISAPPOINTS TOURISTS

Climate and Weather are the very important aspects of tourism sector and climate is the most important factor in tourists' decision making. The choice of the destination largely depends upon the climate of the place. Any change in climate affects the number of visitors as well as the events organized by the tourist operators. Travel to a place can be largely hindered if the climatic condition becomes unfavorable. By saying Climate, we are not talking about the climate on a particular day or time; it is the average climate during a particular season, especially the seasons when tourists come in large numbers. Sometimes an unprecedented change in climate can also cause disappointment to tourists.

To say in a nutshell, no other industry depends upon climate as tourism industry and no other business has customers that depend so much on climate like tourists for their satisfaction. Each and every place like the mountains, beaches, parks, forests, etc., needs the perfect climate to have the best enjoyment from it. The apt climate also helps the travelers to move around safely. Experience of the visitors is more important for the tourism industry to sustain. Many studies and surveys are being conducted on tourists' experience to understand the importance of climate. Most of the people love great climatic conditions like light wind, mild weather to choose a place and to re-visit that place. Storms and heavy rains in a

particular destination strikes off the place from their future visit list. Many people choose to visit high altitude regions to enjoy snow and ice. But due to the increasing temperature, there is less or no snow and the tourists end up regretting for spending so much money to visit that place. For example, Jessica Pociask, an Ecologist and Founder of Want Expeditions, cancelled a tour which she had planned to see harp seals in the Gulf of Saint Lawrence due to lack of ice. There are many such Jessica's who have no other option than to cancel their trip to avoid dissatisfaction. Many even change their dates of travel to high altitude regions to cool themselves from the scorching heat. But sometimes it doesn't happen. There are many places like Ethiopia which were once cool during March but it is not the same now; even above ten thousand feet one can still feel the heat. These are all the consequences of the change in climate.

Let us see the two major impacts of climate changes and the ways in which it affects the tourists (Figure 5.1).

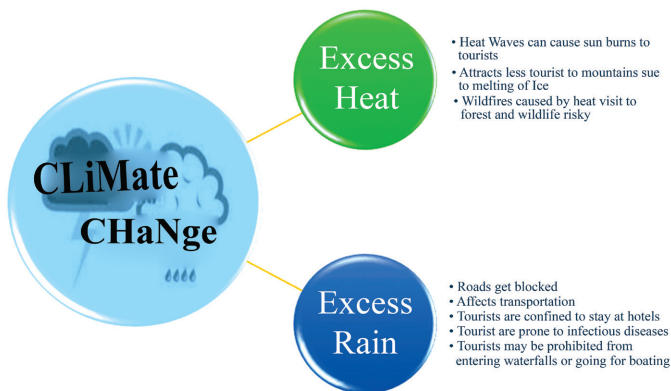


Figure 5.1: Two important impact of climate change to tourists.

In an international survey conducted on 66 national tourisms and meteorological organizations, 81% of them revealed that climate and weather are the major determinants of tourism in their country. The survey made one thing very clear that the global tourists flow is largely dependent upon climate. Climate motivates travel. The travel surveys conducted in Germany, Canada and United Kingdom reveals that weather and climate are the primary travel motivators for majority of tourists. Many other surveys conducted in various countries have confirmed the importance of climate in choosing the timing for holiday travel planning. The people residing in cold countries look for mild, sunny, slight windy regions to go for summer

holidays. Similarly people residing in warm countries look for cold or at least light warm countries but strictly not too hot temperatures for spending their summer holidays. Frequent or heavy rain is a complete no for almost all the survey participants (Figure 5.2).



Figure 5.2: Tourists disappointed at Konark sun temple due to water-logging, (Source: <http://www.naxatranews.com/naxatra/story.php?story=13023>).

Seasonal visits are very much common among tourists. Many tourist destinations arrange for flower shows or skiing events during a particular season and tourists from all over the world eagerly plan and wait for those seasons to see them. But due to climate change, there is change in the timing of plants bearing flowers; similarly skiing is not possible without snow. So the tour operators are forced to close the seasonal events. This is a great disappointment to the tourists who come all the way to take part in it.

When there is too much mist, tourists cannot see the natural sceneries. They cannot even take bath in waterfalls when there is a heavy rain as the entry will be prohibited considering safety issues. Although these occurrences do not please tourists, it is further more discouraging for the first time visitors as they may lose interest in travel totally.

Meghan McPherson, a faculty at Adelphi University's Emergency Management Program says that, "Weather events are becoming more frequent, more severe and, in many cases, the seasons in which we worry about them are becoming longer. Much of our infrastructure was designed to function in the climate in which it was created. Because of this, roads that never flooded even 10 years ago are now flooding in everyday rainstorms. Our planes are unable to take off in heat they were not designed to withstand."

According to Dan Boland, a commercial airline pilot, ‘during a heat wave the air is less dense and so the jet engines produce less thrust. Less dense means less power and it becomes almost impossible to safely take off at temperatures more than 38°C with full passenger load. So travelling to destinations in hot weather is also not safe for the tourists.’

Many people like to visit the places that are seriously impacted by climate change because these places may not exist in near future. Many wish to see the endangered species. But they may regret later for their choice of destination since the weather becomes unbearable. Many people are ready to explore the regions where the climate change is very frequent but they face the risk of doing so. There is not even one tourist attraction which is not climate sensitive. Climate decides the travel plan of the tourists as well as the tourism operators.

High temperature creates irritation among tourists but more than heat, rain and storms are found to make more negative influence on travel decisions. People plan travel and choose destinations in order to relax from their stressed life. But the ongoing climatic changes make travelling and sightseeing more stressful than what they already suffer in their daily lives.

5.2. LOSS OF REVENUE FROM TOURIST RELATED ACTIVITIES AND IMPACT ON OTHER BUSINESS

Tourism industry is one of the main revenue generators for many nations. Tourism is the main source for employment, growth and infrastructural development in these countries. We saw in the earlier section that climate change impacts the tourists flow to a particular destination. Travel and tourism industry has already started to face the consequences of changing weather patterns. Tourism industry largely depends upon the arrival of tourists in large numbers. There are also other industries that grow along with the tourism industry. If one gets impacted, all the others get affected as well.

Before we get into the topic of how tourism is affected by climate change, first let us see the important components of the tourism sector that acts as a source of revenue for the nations (Figure 5.3).



Figure 5.3: Revenue generating areas of tourism sector, (Source: <http://slide-player.com/slide/6112686/>).

Now let us see how a change in climate collapses the tourism business and other businesses. The very important negative impact of climate change is the increase in temperature. People in colder regions will choose the destinations with mild warm weather to indulge in sunbathe. But when the temperatures rise above 40°C, which is a normally occurring temperature in warm countries, it becomes hard for the tourists to sustain this temperature.

Coastal tourism will get affected due to the increased acidity of oceans. Since the amount of Carbon dioxide absorbed by the oceans becomes more, the marine life gets affected. Many tourists prefer coastal tourism in order to see the marine world and its rare species. Due to the reduction of unique kind of fishes and corals, tourists will not show any enthusiasm in visiting such tourist destinations. This will impact the tourist service providers and other services like boating, snorkeling, etc. About one-third of the revenue generated out of tourism comes from coastal areas, beaches and coral reefs. Lakes are also getting dryer due to low precipitation levels. This is dangerous as boaters may hit some dangerous obstacles in the water. Because of the climate change impact, the developing countries are losing a large amount of income that comes from coastal tourism.



Figure 5.4: Less number of Skiers due to less snow, (Source: <https://www.japantimes.co.jp/news/2015/12/29/world/science-health-world/switzerland-kept-records-150-years-december-clocks-warmest/#.W6iLMnszblU>).

Winter tourism in snow covered regions is taking a toll as the rising temperatures have reduced the snow cover on the mountains. There is great threat on the snow sports such as skiing and snowboarding. It is predicted that in some regions these sports events may no longer exist after a few years. The economy of tourist places have started to fall as the attendance of tourists is less, due to lack of winter sports and other activities. Since the snow seasons are shrinking, the tourist operators are losing many profitable days (Figure 5.4).

Tourism industry invests a lot on outdoor recreation activities and even tourists spend a lot to participate in them; so when the results do not come as expected, it results in disappointment and loss. The consumers in U.S. spend more than \$900 billion on various outdoor activities every year. We can now assume the resulting impact when the events get cancelled due to rain or any other climatic reason. According to James Roger, Senior Director of Sustainability for The North Face, the international outdoor clothing and gear manufacturer, the economic impact of a low snow year may add up to \$1 billion to \$2 billion annually. Apart from sports, the climate change has impact on the sales also. Travellers would love to purchase winter clothing or any other accessories from the cold destinations, but when the climate change eradicates the need, the local clothing business will also suffer.

According to 2017 Outdoor Industry Association's report, the outdoor recreation economy of America is valued at \$887 billion annually and millions of employees are dependent on this industry. When the climate

change affects the visit of parks and other recreations, it has impact on these million jobs. Many outdoor recreational activities are limited due to the scorching temperatures. Extreme weather events such as hurricanes, increased sea level, heat waves, heavy rains, floods and droughts are all caused by climatic changes. These weather events affect every outdoor recreational activity right from cycling to hiking.

Some outdoor recreational activities like kayaking, whitewater rafting and other activities that depend on water are facing disruption due to the climate changes as the water levels may be too low for kayak or canoe or alternatively the places might have got damaged due to storms and flooding. The reduction in the activities reduces the number of travelers which indirectly impacts the business of hotels, resorts, water transport services, food service, etc., It is actually a chain reaction that is felt by every business.

Adam Cramer, the Executive Director of the Outdoor Alliance, an advocacy coalition of human-powered recreation organizations says, "It is important to understand that it is not a linear progression of changes. What we are seeing now is that there is more variability and less reliability in the seasons and in the weather. Disrupted weather patterns are definitely becoming more common than what used to be the norm of predictable weather."

The Climate change is happening and it is very true. It has direct as well as indirect impacts on the water resources as well as the landscapes. Many popular travel destinations are losing their popularity. Business performance in hotels and resorts will be affected due to water scarcity and changes in seasonality. Now let us see in detail as how the businesses that depend on tourism are losing their revenue from climate change:

5.2.1. Resorts and Hotels

As we all know the rise in temperature results in melting of snowcaps in the mountains as well as cause floods in the coastal areas. The Ski operators in Australia, Japan, North America and the European Alps are going to have less business due to the melting of snow caps and due to shorter seasons. Without the amount of expected snow, the ski resorts will lose their customers.

Melting of ice causes increase in sea level and this may turn as floods and wash off the attractive coastal areas. If flooding occurs, beach resorts will get destroyed and arrival of tourists to the beaches will stop. Right from the resort owners to the staffs who are employed there, will lose their jobs (Figure 5.5).



Figure 5.5: Rising sea level panama floods a resort, (Source: <https://www.youtube.com/watch?v=ygA1WBKFMzM>).

Resorts and hotels, especially the ones located in the coastal areas are more vulnerable to climate change impact like rising sea levels. These hotels and resorts would have invested a huge amount of money to attract tourists and to provide services. But when a huge storm comes ashore, these resorts fall as a meager prey. The resorts will lose its properties and it is also very hard to make an insurance claim. Hotels may have valued assets to attract customers and these cannot be re-located so easily as and when climate change occurs.

5.2.2. Transportation Service

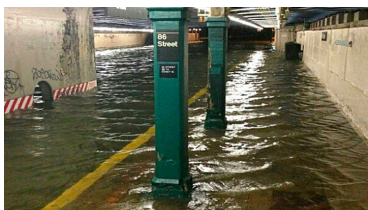


Figure 5.6: New York City subway stations flooded by hurricane sand, (Source: https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-transportation_.html).

Airlines face a severe problem of re-routing when there is a sudden problematic weather in the destination location (Figure 5.6). Sometimes flights have to be cancelled foreseeing the hazardous climate. Due to increasing climatic changes many tourists may change their decision in the last moment and cancel their trip. All these are lose to the airline industry, considering the fuel and other costs in addition to the operation costs that the industry bears.

The climate change does not pose threat to the airline industry alone. Bus, train and boat services are also equally affected. Heavy rainfall and

floods may damage the bus and train routes and makes travel difficult. Even the vehicles may get damaged. Transport through ship or boat is highly impossible when there is a high tide. The infrastructure gets damaged and it is a loss to everyone.

Tourism Services

Due to the increased risk caused by climate change, the airline services and all other tourism related services have increased their costs and this is a great challenge for the tourist operators as well as online travel booking companies as they have to cope up with the increase in price. But the problem here is that in the process of increasing their fare, they are likely to lose their customers, as travellers look for the best and cheap deals for their trip. Travel and tourist companies try hard to match their operating costs.

Climate change plays a crucial role in obtaining profit as well as loss from tourism. The tourism industry has seen many such occurrences in the past as well as in the present. After the devastating fire that happened in Greece during the summer season of year 2000, more than half of all the bookings for the next year to Greece were cancelled. Similarly drought in the Colorado state of United States during 2002 resulted in dangerous wildfires and this was exposed to the world by media and this had a huge impact in the summer tourism. The number of tourists declined by 40% in some areas of Colorado and the reservations made in the state park campgrounds lowered by 30%. Fishing and river-rafting tourism got severely affected by drought. Some of the river-rafting outfitter companies had a loss of 40% in their normal business and the total state's river rafting industry alone faced an economic loss that exceeded \$50 million.

5.3. INCREASED RESTRICTIONS IN TOURIST DESTINATIONS DUE TO CLIMATE CHANGE IMPACTS

As we all know tourism is a highly growing global industry that creates millions of employment opportunities as well as serve as the main source of income generator for many countries. But for tourism industry to continue providing these benefits, the industry should first survive. Tourism industry can survive only when the tourist destinations remain attractive as ever. The effect of climate changes is leaving its mark in these destinations and if no action is taken, we may have to lose these destinations for ever and there will be no need for a tourism industry. In order to retain the benefits of

tourism industry and more importantly to retain nature, the tourism industry have already started imposing some strict restrictions in certain destinations which are at the risk of damage.

The varying climatic conditions are already causing huge impact on the natural attractions. The humans as tourists are adding up to this problem. Tourists and other tourism business operators knowingly or unknowingly are spoiling the environment and are reducing the life of the destinations. This should be stopped; placing restrictions is the only way to do it. Travel and Tourism is actually destroying the local ecosystem and contributing to the global climate change. Whether it is the huge carbon footprints generated by air travel or the humans damaging the environments, the ways and means of travel and tourism needs to be addressed and taken care of. All the climatic changes that we are experiencing now have the potential to damage or destroy the very elements that attract tourists. Environmental degradation and climate change can dramatically disrupt general tourism patterns.

As no other industry has this vast impact due to climatic disorders, tourism industry has decided to go environmental friendly. The industry has started placing many restrictions in order to preserve the tourist destinations. Even the governments are pushing for additional measures to find long-term solutions.

Creating a sustainable tourism strategy is the only way to protect the ecosystem. In order to cope up with the impact of climate changes and to prevent further damages, the tourism industry is posing restrictions and is strict in the areas as given in the below diagram. If these four key issues are addressed then sustainable tourism is not at a long distance. Once these issues are understood then, tourism operators and policy makers can develop a green strategy for their destination (Figure 5.7).

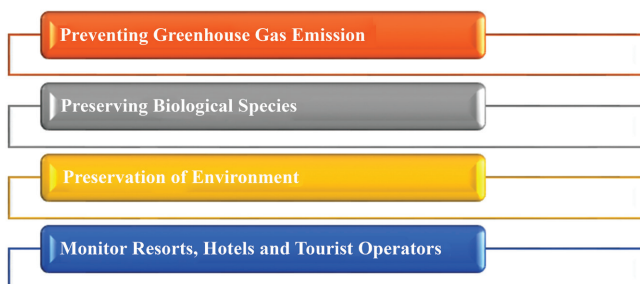


Figure 5.7: Preventive measures to protect tourist destinations.

5.3.1. Preventing Greenhouse Gas Emission

Tourists must be watchful not only for leaving dirty footprint but mainly for leaving carbon footprint if they wish to re-visit the place. Increased carbon emission is one of the major factors affecting climate. It is found that the tourism industry contributes 5% of global carbon emissions mainly caused from air travel and lodging. According to a recent study conducted by the World Economic Forum and Booz & Company, if no actions are taken to reduce these emissions, it is likely to double by Year 2035. Reduction in Carbon emissions will also help in saving energy and materials and act as a cost-effective measure.

Many hotels and resorts are adapting the green technologies and policies and are contributing to sustainable tourism. For example, AquaCity resort, one of the popular resorts in Slovakia cuts nearly 27 tons of Carbon dioxide from entering the atmosphere everyday by using geothermal water and solar energy (Figure 5.8). This practice has also helped the resort in saving millions of Euros every year. For this great initiative, AquaCity resort was designated the World's Leading Green Resort by World Travels Awards.



Figure 5.8: Aqua City resort in Slovakia, (Source: <http://www.discover-ce.eu/tourist-products/active-holiday/slovakia/fun-in-water/?lang=zh-CN>).

Vancouver's Fairmont Waterfront hotel has also implemented a plan to reduce emissions. They work on a heat recovery system which captures steam from hot water tanks that has been condensed back into water which again heats the incoming city water. Using this technology, Fairmont Waterfront Hotel has saved an estimate of 305,380 kilowatt-hours of electricity per year which is equivalent to the annual energy needed for seven private homes.



Figure 5.9: Fairmont waterfront hotel, Vancouver, (Source: http://luxuryhotel-experts.com/property.php?hotel_ID=39).

As a way to reduce greenhouse emissions, the government promotes ecotourism in Phuket island of Thailand. The island already practices the concept of Carbon Neutral by which people in the island become environmental stewards and it becomes their duty to protect and conserve the natural resources for future. The Carbon Neutral Concept program also calls for individuals and businesses to measure and limit their carbon footprints.



Figure 5.10: Electric cars for tourists in Ha long, Vietnam, (Source: <http://vietnamtourism.gov.vn/english/index.php/items/8998>).

Since most of the carbon emissions are occurring from means of travel, tourist destinations are advised to use local mobility systems to avoid destructive traffic. Electric cars or cars using eco-friendly fuels are promoted in most of the destinations where there is a vast area to cover by the tourists. Tourists are not only attracted towards the place but they would

love to experiment new ways of travelling in new places if they are given the right opportunity. In this way tourists will be happier and there will be less pollution (Figure 5.10).

Paris also sets an example of such practice. The Velib bicycle co-op program was implemented in Paris in 2007. This program gave not only visitors but also the residents an opportunity to reserve bikes, use them and return it. This facility was initially started in 750 locations and now the city has more than 230 miles of bike lanes with further plans of expansion (Figure 5.11).



Figure 5.11: Tourists using Velib bicycle, (Source: <https://averagejoecyclist.com/make-cycling-normal-learned-cycling-paris/>).

Many countries have come forward to use more such ways. As an alternative to bus transportation, Israel has created a network of bike trails and walking paths for Christian pilgrims going from Nazareth to the Sea of Galilee. Even Switzerland, a great tourist place has set a trend with e-bikes powered by lithium-ion batteries for tourists to travel around (Figure 5.12).



Figure 5.12: E-bikes in Switzerland, (Source: <http://globetrotter-magazin.de/magazinartikel/travel-guide-5-outdoor-trips-switzerland>).

Destinations are advised to incorporate more carbon-friendly principles into their supply chains and purchase sustainably sourced goods and materials. Implementation of low-carbon waste management policies including energy-efficient recycling must be practiced. Even attempting a small change gives a lot of benefits. A one year project in Tasmanian hotels funded by the government saw a reduction in their energy use by one-third by installing insulation, sectioning of rooms and repositioning windows. The project saw a drop in the Carbon emissions by 104 tons which is equivalent of using 24 cars a year.

The restrictions that are placed in certain destinations for reducing Carbon emissions may seem harder but when we understand the positive effects derived out of it, surely it will be worth adapting. Some destinations are motivating tourists by creating incentives to offset their remaining emissions through local donation programs that invest in renewable technologies. For example, the world renowned tour operator Thomas Cook requests clients to donate £2 (US\$3) that it matches and funnels into emissions-offset projects.

5.3.2. Preserving Biological Species

Tourists are very keen on visiting destinations where they can find nature's most unique creations. This makes those destinations and the species even more precious. For the past two decades alone, tourists visiting biodiversity hot spots have increased to more than 100%. Though the tourists are aware of the uniqueness and value of the species, they do not show much importance to preserve them or not to cause any damage to them. Because of their importance and decline in number, it has become all the more important to safeguard the species which may otherwise become extinct. Strong regulations are brought into practice since unregulated wildlife viewing in places such as Caribbean wetlands and New Zealand have disrupted the feeding and nesting sites of birds, animals and other species. Due to increased movement of cruise ships, diving and other activities, coral reefs are dying. Hence diving is restricted in some areas to preserve the remaining reefs.

The destinations that need to be protected from human interference and where there is rich ecosystem are declared as World Heritage Sites. For example, UNESCO declared the Wadden Sea of Germany and the Netherlands a World Heritage site in June 2009 as these countries' traditional reverence for nature has helped them preserve their environment, even as they welcome more tourists each year. The biodiversity of Bhutan are still

preserved, because 72% of Bhutan is still forested and it is not disturbed. Many mountains in Bhutan have been closed for trekking to avoid littering and pollution and parts of Bhutan have been declared wildlife reserves. Tourist departments and the governments are regulating many policies to protect the indigenous species.



Figure 5.13: Bhutan preserving its nature. (Source: <http://www.swantour.com/blogs/places-to-visit-in-bumthang-bhutan.php>).

5.3.3. Preservation of Environment

A clean, healthy and beautiful environment is definitely a plus point for a tourist destination. But keeping it always clean is a tedious task. The environment can very easily be spoiled by the tourists, by local residents and by industries also. All these impacts on the environment adversely affect the climate and the climate change in turn impacts the destination. One of the major pollutants that affect the environment is the garbage. Apart from destroying the pleasant look of the destination, waste or garbage affects the soil as well as water quality. Accumulation of garbage pollutes the air and tourists are at the risk of contracting diseases.

Waste comes from different sources. The increasing number of tourists itself is a main reason for accumulation of waste. The sewage coming from hotels and cruise ships contaminate water in the coastal areas. This is treated as a serious problem because during the mid-1990s, more than 70,000 tons of liquid and solid waste was thrown in the Caribbean Sea by cruise ships. One of the world's most beautiful places Venice was forced to withdraw its application to host Expo 2000, a global exhibition out of fear from the tourist behavior. The waste produced by the large number of tourists in Venice during the past decades has led to pollution and flooding of iconic canals in the city. People of Venice are very much scared of their own future due to the increasing number of tourists (Figure 5.14).



Figure 5.14: Garbage dumped by the cruise ships in the Caribbean sea, (Source: <https://www.youtube.com/watch?v=OHrc7zVAmvI>).

The Tourism boards in many destinations are working to find out a creative solution. They are adapting measures to reduce waste coming from all sources and also try to recycle them. By this, the destination can be kept clean and healthy and this will improve the reputation of the place and attract more tourists. Tourist organizations are also working on generating energy out of waste. Since there are many restrictions laid on waste management and due to continuous monitoring, many hotels and lodges are using green waste in vegetable gardens.

Israel is taking tourism to next level. The country has transformed a huge garbage dump which is on the outskirts of Tel Aviv into a 2000-acre park with a picnic area with provision for hiking and cycling and there is also be a recycle plant. They are also planning to open an education center where tourists will be allowed to view the recycling process and understand its importance for a healthy environment (Figure 5.15).



Figure 5.15: An arch made of plastic bottles at Tel Aviv, (Source: <https://www.nytimes.com/2007/10/24/world/middleeast/24dump.html>).

The Boracay Island in Philippines is well known for its white and powdery beaches with long shorelines. The tourists and the resort operators here are asked to follow certain climate friendly measures that have been designed by the local government along with the help of various environmental groups like Green Peace Solar Generation Youth. The measures include responsible tourism, zero wastage and energy efficiency. A few examples of energy efficiency measures include – using solar panels for powering laptops and using batteries to operate cars and motorbikes.

Water is also an important resource that can be wasted very easily. The hotels and resorts in the tourist places need water for their swimming pools and for other purposes. A continuous supply of water is essential for sustaining the environment. For disrupted availability of water, the consumption of water must be measured and controlled. Even the usage of water must be reduced to the minimum level possible. A destination can increase its potable water capacity by cleaning and re-using wastewater. This also helps in reducing sewage and pollution.

Kenya follows great methods to preserve the environment and water. Lodges located in the semi-arid environment of Kenya have introduced methods such as restricted water pumping during certain hours on the day, installation of low pressure showers, using recycled water and rainwater and encouraging guests to reuse towels. These lodges and resorts are also planting trees as a source of firewood and as a protective measure for water catchment. The need for environment preservation arises when the number of tourists' arrival is greater than the capacity of the destination to handle. This causes dangerous threats to the environment such as soil erosion, disposal of waste into the sea, increased pollution, change and loss in natural habitats of some species, increased pressure on the endangered species and declining in forests. When the environment is in grave danger, it affects the availability of natural resources and the situation will become worst as the locals will have to compete with the tourists to procure the needed resources. In order to prevent all this, tourists organizations are placing restrictions in the number of visitors allowed per day to a certain destination. Mountaineer Sir Chris Bonington has called the base camp of Mount Everest as, "the world's highest garbage dump." This is very true as most of the climbers do not care about the litter that they leave on the mountains. By the efforts from the local Sherpas and the Nepal Mountaineering Association, the government of Nepal is charging a deposit from climbers which are refundable if they bring back the disposable things with them when they return (Figure 5.16).



Figure 5.16: A volunteer clearing garbage dump at Mt. Everest, (*Source: <https://www.hometowndumpsterrental.com/blog/new-law-will-clean-up-mount-everest-worlds-tallest-garbage-dump>*).

Overcrowding leads to so much humidity that it causes fungus to grow on the walls of some buildings with architectural importance. The Egyptian authorities are now planning to close some of the tombs and replace it with replicas as a way to preserve them. More planning is required to preserve the environment that too in a world where climate change is so fast than ever in history. Tourism operators and the government should work together to make this happen.

5.3.4. Monitor Resorts, Hotels, and Tourist Operators

If tourists contribute to the changing climatic conditions, so are the resorts and hotels that accommodate them and also the tourism operators who plan events for entertaining the tourists. We saw in the earlier section on how hotels and cruise ships contribute to dumping of garbage. The tour service providers plan many activities such as boating, diving, snorkeling and fishing to keep the tourists engaged. The tourists involving in these activities damage the coral reefs in many parts of the world by touching them and also by misusing their anchors. The increased number of boats and the closeness of humans disturb the marine animals like seals, sharks, dolphins, whales, dugongs, etc., Increased number of tourists means increase in sea food consumption which contributes to over fishing and this reduces the fish population. Effective ways needs to be planned to avoid all these damages and the strategy must be planned in a way that it should not conflict with the tourism industry and do not de-motivate the tourists. Strict application of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment procedures are levied on all tourism related projects and programs. Buffer zones are created around sensitive natural areas. Sports or activities that harm the environment are identified and restricted. The tourism board has a watch on maintaining

the right environmental standards. Having these restrictions is not only a benefit to the destination but it is equally good for the tourists who will be able to spend quality time breathing clean air and using clean water. Tourism is a billion dollar industry and it has that much impact on the destinations as well. Unlike past, tourists of today prefer green tourist destinations that address the key critical issues such as carbon emission, water availability, waste management and biodiversity conservation (Figure 5.17).

Since people are willing to contribute, the tourism organizations should come up with more innovative ideas and also educate the people about the environmental importance and the role of it in climate change. Since the tourists themselves are willing, the leading global tour operators such as TUI and Thomas Cook are giving preference to environmentally sustainable destinations and are also marketing them. Moreover they demand higher green standards from hotels and resorts (Figure 5.17).

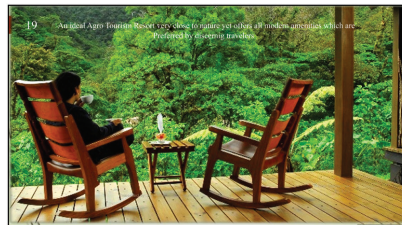


Figure 5.17: Green tourist destinations preferred by tourists, (Source: <https://www.slideshare.net/SubodhGupte/agri-tourism-concept>).

Not all destinations are adapting to the green challenge; many still lag behind. Major global travel societies such as National Geographic are now considering environmental sustainability as a major criterion for their destination rankings. The examples that we saw in this section about destinations implementing practices for preserving environment is only for the local areas. These efforts must be combined and a long-term solution needs to be found to retain global tourism industry and tourist destinations. Meaningful changes should be brought out by following environmental policies and procedures. Restrictions posed on destinations must not remain in papers or boards alone. They should be strictly followed.

5.4. DISAPPEARING TOURIST SPOTS

As we all know, nature's beauty is endless. Right from small beautiful lakes to large oceans, ice clad mountains, glaciers, forests, different kinds of wildlife,

islands, etc., Earth has everything that the humans cannot even imagine to create by themselves. But these wonders are at the risk of destruction due to climate change. In this Chapter, we learnt about how climate is important for tourists and why preventive measures needs to be taken for sustaining tourist destinations.

Due to certain factors like climate change impact, lethargic behavior of tourists and no proper management system by tourism boards, many tourist destinations are on its way of extinction. Some have already started to deteriorate. Let us look into some of the tourists' destinations that currently are or could be in danger:

5.4.1. Mt. Kilimanjaro, Tanzania



Figure 5.18: Reduced snow at the top of Mt. Kilimanjaro, (Source: <http://alive2green.com/tanzanias-unique-park-tourists-overflow-well-conserved-glaciers/>).

“The Snows of Kilimanjaro” is soon to be found only in the work of Ernest Hemingway. More than 85% of the ice on Mt. Kilimanjaro, one of the tallest peaks of Africa has already melted away during the last century. Climate change and deforestation are said to be the main factors for the quick disappearance of this famous attraction. According to Scientists, the mountain glaciers which are believed to be at least ten thousand years old might completely vanish from the peak within the next two decades (Figure 5.18).

5.4.2. Columbia Glacier, Alaska



Figure 5.19: The shrinking Columbia glacier of Alaska, (Source: <https://www.telegraph.co.uk/travel/lists/bucket-list-destinations-that-may-disappear-climate-change/>).

Glaciers all over the world are retreating in a more rapid way than as predicted by experts. One such glacier that is shrinking very quickly is the Columbia Glacier of Alaska. Currently the Columbia Glacier stretches from mountains on Alaska's southern coast into bays of the Gulf of Alaska. The glacier is reducing in size due to retreating and the scientists predict that the stretch will shrink to just 26 miles long by Year 2020. The Boston Globe has reported that the glaciers of Alaska are warming five times faster than any other parts of the world (Figure 5.19).

5.4.3. Island Nation of Tuvalu



Figure 5.20: Rising sea level in the Island nation of Tuvalu, (Source: <https://www.xatakaciencia.com/cambio-climatico/se-cuadruplicaron-los-desastres-naturales-en-los-ultimos-20-anos>).

Tuvalu is an island in the Pacific Ocean and it is only 15 feet above sea level (Figure 5.20). Due to fear of rising waters, the people are planning to evacuate the island before it gets submerged totally. Not only Tuvalu, but other neighboring nations of Kiribati and the Maldives in the Indian Ocean may also disappear, says Dr. Clive Hamilton, Executive Director of the Australian Institute Think Tank.

5.4.4. The Dead Sea



Figure 5.21: The Dead Sea and the sinkholes, (Source: <http://www.muslim-daily.net/berita/laut-mati-menyusut-menyisakan-lubang-lubang-neraka.html>).

The developments started in the nearby regions have made Dead Sea to lose one-third of its surface area. Building of dams, pipelines and storage reservoirs for the past years has led to the reduced inflow of water. Sinkholes are visible in the places where water has receded. More than 3000 sinkholes can be seen on the shoreline. The Dead Sea is losing some 2 billion gallons of water per year due to large-scale mining operations and because of diversion of water from the Jordan River, which is the main source of water for the Dead Sea (Figure 5.21).

Since the minerals of Dead Sea are well known for its therapeutic use, the cosmetic companies are illegally extracting them. Due to the high temperature in the Middle East region, it is extremely difficult for the sea to replenish itself. The Dead Sea is already shrinking at a rate of 3.3 feet a year and experts say that if this rate continues, the Dead Sea could dry completely by Year 2050.

5.4.5. The Amazon Forests



Figure 5.22: The Amazon rainforests, (Source: <http://clubbioman.com/state-of-amazon/>).

Amazon is the largest rainforest on Earth and it covers nearly 40% of South America. This forest is the habitat for many unique varieties of wildlife species (Figure 5.22). It is said that at least 441 new species of plants and animals were discovered in the Amazon rainforests in just three years. Tourists go to Amazon to find blue poison dart frogs, scarlet macaws, jaguars, brown-throated sloths and many more creatures. But the frequent climate change is converting Amazon into a poor habitat for these species. Due to extreme droughts the trees throughout the forests have become drier that they have become vulnerable to forest fires.

5.4.6. Mergui Archipelago in Myanmar

Mergui Archipelago is known for its coral reefs and various marine species. Due to coral bleaching and excessive fishing, especially the use of destructive fishing methods by commercial fisherman, the coral reefs are getting damaged. The semi-nomadic Moken people in the islands of Mergui Archipelago rely on the coral reefs and the other species for their living. Mergui Archipelago is not only facing the danger of losing its coral reefs but also the Moken people (Figure 5.23).



Figure 5.23: Moken people are forced to leave, (Source: <https://www.seal-superyachts.com/among-the-moken-the-sea-gypsies-of-myanmar/>).

5.4.7. Glacier National Park in U.S.



Figure 5.24: Melting glaciers of glacier national park, U.S., (Source: <https://www.greenandgrowing.org/glacier-national-park-glacier-melt/>).

Glacier National Park is located on the U.S. Canada border of Montana and it spreads over a million acres. The Park is a great tourist destination and has attracted nearly 3 million visitors in 2016. There are hundreds and thousands of animals and plants in the park including the glaciers which is

the main attraction here. But due to increasing temperatures, the glaciers are reducing (Figure 5.24).

As per the data released by the U.S. Geological Survey and Portland State University during May 2017, a warm climate that is in existence since 1966 has significantly reduced the size of glaciers in the park. Out of the 150 active glaciers, only 25 remain today. The rise in global temperatures makes the shrinking faster. This is an alarming situation for the park's ecosystem. As the glaciers melt, entire ecosystems will be altered and scientists predict there will be little ice left after a couple of decades—and none at all by the end of the century.

5.4.8. The Alps



Figure 5.25: Retreating glaciers in the mountains of south Tyrol, Central Alps, (Source: <http://cms.herbalgram.org/herbalgram/issue81/article3379.html?Issue=81&ts=1523615480&signature=bcd433f2d95b353e1c200392a046157d>)

This European mountain range is a favorite destination for skiers as this range stretches across eight countries providing some of the most sought-after slopes in the world. The winter sports conducted here attract tourists from all over the world. But due to increasing temperature and melting of snow the length of winter season is getting reduced.

The Organization for Economic Co-operation says that the Alps mountain have been warming three times the global average. Since winter sports cannot be conducted due to reduced season, many resorts have started

to compensate the visitors by offering spa treatments and other outdoor activities like horse riding. Also skiing on the slopes has become very risky due to the retreating glaciers and heightening of snow lines. If the same situation persists, the Alps will be out of the tourist attractions lists very soon.

5.4.9. Venice



Figure 5.26: Sea level rise in Venice, (Source: <https://e360.yale.edu/features/rising-waters-can-a-massive-sea-barrier-save-venice-from-drowning>).

Out of the many tourist destinations, Venice is at the edge of danger and the beautiful streets which are made out of water are at the risk of floods due to rise in sea level (Figure 5.26). The overcrowding tourists and more number of cruise ships will make the city submerge in water.

5.4.10. Caribbean Coral Reefs



Figure 5.27: Fishes missing from Caribbean Coral reefs due to increased acidity, (Source: <https://news.scubatravel.co.uk/caribbean-coral-reefs.html>).

The Caribbean Coral Reefs is one of the major tourist destinations for divers. Due to the absorption of enormous amount of Carbon dioxide, the oceans are becoming more acidic. Corals lack calcium as the acidity level increases and thereby gets destroyed (Figure 5.27). According to the World Resources Institute, “If local and global threats are left unchecked, the percentage of threatened reefs will increase to more than 90% by 2030 and to nearly all reefs by 2050.” Coral Reefs of Caribbean will no longer exist.

5.4.11. Australia’s Great Barrier Reef



Figure 5.28: The dying great barrier reef of Australia, (Source: <http://www.travelandleisure.com/travel-tips/responsible-travel/great-barrier-reef-severe-bleaching-photos>).

Great Barrier Reef of Australia which was ranked by U.S. News and World Report as the Best Travel Destination is one of the Seven Wonders of the World and also a UNESCO World Heritage Site. The biggest attraction of these coral reefs is their vibrant color which is derived from a tiny alga called zooxanthellae living in the corals (Figure 5.28). The oceans are facing rise in temperature due to climate change and increase in acidification which affects all organisms in water including this algae. When the living conditions change, this algae move to some other locations leading to mass coral bleaching. 93% of the coral reefs are already affected by the bleaching epidemic. The global warming is affecting its ecosystem very badly and the Great Barrier Reef may not survive for longer period if this warming continues.

5.4.12. Galapagos Islands, Ecuador



Figure 5.29: The Galapagos Island and the vanishing penguins, (Source: <https://www.atlasandboots.com/landscapes-affected-by-climate-change/>).

Galapagos Island is known for its biodiversity. The island is experiencing drastic changes due to climate change. The coral reefs, the algal blooms and the marine species are dying because of the rise in ocean temperature (Figure 5.29). Due to the decline in marine life many land animals that depend on them are also getting affected. The nesting grounds of the Penguins are vanishing due to the rise in sea level. The government of Ecuador is implementing various steps like building ‘Penguin condos’ and restricting the visit of tourists to the island in order to safeguard the island from destruction.

5.4.13. The Rainforest of Madagascar

Due to deforestation, the Madagascar rainforests which were once 120,000 square miles has now decreased to 20,000 square miles (Figure 5.30). The Madagascar rainforests are very famous for the vast number of unique species that are found here. Mostly 75% of the species living here cannot be found anywhere else in this planet. Few examples are tomato frogs, flat-tailed geckos and comet moths. Still lot of species residing here are yet to be discovered. But there is an alarming threat that these forests may fully vanish before these species are even found out.



Figure 5.30: Deforestation in the rainforest of Madagascar, (Source: <http://gazeta-shqip.com/lajme/2013/09/23/prerja-e-paligjshme-e-pyjeve-kapen-gjashte-makina-dru/>).

5.4.14. Maldives



Figure 5.31: The disappearing Maldives, (Source: <https://www.quora.com/What-is-the-best-time-to-visit-Vaadhoo-Island-in-the-Maldives>).

Maldives, one of the lowest lying countries on this Earth comprises of numerous islands in the Indian Ocean. It is anticipated that the increase in sea level may submerge the whole country (Figure 5.31). The very act of the Maldivian government of buying land in other countries for its people denotes the seriousness of the problem. The Paradise on Earth may be lost forever if the climate change pursues.

Our Planet Earth is bestowed with beauty and wonders. Even the modern technologies cannot re-create any place with the same magnificence. It is up to the humans to reduce the activities that can cause changes in the climatic conditions and impact these attractions. Moreover many people have started to visit these places in the fear that these places may not be there in future and they may miss the opportunity to see it in future. In reality the overcrowding in the tourist destinations are only worsening the damage. Humans should understand this and act accordingly to preserve our natural wonders.

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CHAPTER 6

IS TOURISM A CAUSE FOR CLIMATE CHANGE?

“It’s not an investment if it’s destroying the planet.”

—Dr.Vandana Shiva

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Climate change does not happen in a single day and it is not caused by a single event. Many factors contribute to the Climate Change. One such stem of contribution comes from tourism industry. Although tourism industry relies so much on climate for its growth, the industry either knowingly or unknowingly adds fuel to increase in climate change. This chapter throws light on how tourism industry affects the environment and subsequently the climate. We will also look at the direct and indirect impacts of tourism industry over climate. In the earlier Chapters, we learned about how the change in climate affects the various tourism activities and other businesses. In this Chapter, we will look at how the tourist activities and other ancillary businesses alter the already changing climate.

6.1. TOURISM: A CONTRIBUTOR TO CLIMATE CHANGE

In today's world, many of us literally wait for a full year to visit our dream destinations. This trend is just increasing among people across all classes. According to the available data, the global international visitor arrivals went beyond 940 million in the year 2010 and the World Tourism Organization predicts that this number may reach 1.6 billion by 2020. This clearly states that people are not going to stop touring. Hence travel and tourism is not going to exist forever. But nowadays we hear a lot about climate change and tourism and tourism is considered to be one of the main contributing factors to climate change. As the flow of tourist increases, the transportation also increases and this leads to many adverse effects which cause everlasting impact on the climate (Figure 6.1).

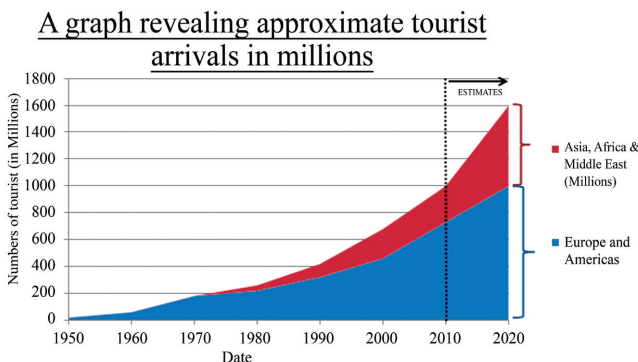


Figure 6.1: Trend in growth of tourists, (Source:<http://www.coolgeography.co.uk/GCSE/AQA/Tourism/Tourism%20growth/Tourism%20Growth.htm>).

Tourism is fun and for almost all travelers, it is a lifetime experience but it also has negative impacts which may take lives from this planet if not addressed carefully. Tourism is a global industry and it has its own positives and negatives. Although people are very much happy and contented with the positive side of tourism, it is actually the negative side one must give more importance. The various setbacks of tourism are listed in the below diagram (Figure 6.2).

Let us now look into each topic in detail.

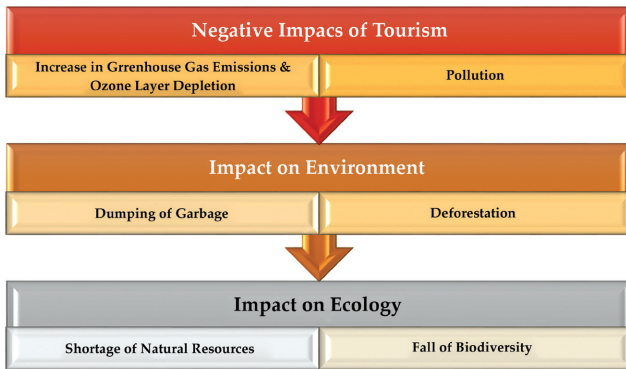


Figure 6.2: Negative impacts of tourism.

6.1.1. Increase in Greenhouse Gas Emissions and Ozone Layer Depletion

Tourism is considered as a significant contributor to climate change as it highly depends on fossil fuels for many of its activities. According to recent estimates, tourism on the whole which includes transportation, accommodation, and other activities contributes to approximately 5% of the total greenhouse gas emissions occurring worldwide. This is because of the increase in the number of travelers and astonishing growth of tourism industry. Out of the 5% of greenhouse gas emissions, majority of it, say 50–98% of it is caused by transportation mediums such as planes and cars. The remaining of it comes from tourist accommodations such as hotels, resorts and from other leisure activities (Figure 6.3).

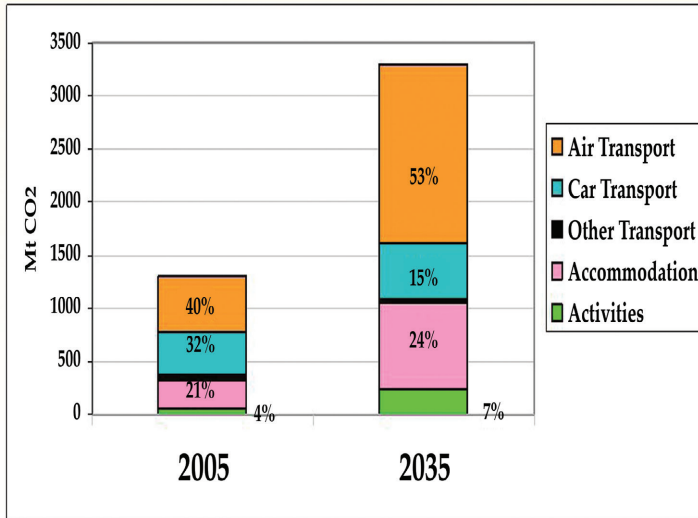


Figure 6.3: Carbon dioxide emissions from tourism, (Source: <http://slideplayer.com/slide/2375210/>).

People move from their homes to tourist destinations using various transport mediums, the main one being planes. The emissions coming out of planes contribute largely to climate change. As the number of tourists increases, the frequency of travel services also increases resulting in too much of emissions. Pamela Nowicka, an U.K. based author and film-maker who is a regular visitor to South India for last two decades says, “Holidays are a luxury consumer item that produces enormous amounts of Carbon emissions. Carbon emissions from flying causes a rise in temperature, which in turn leads to climate change and drought but people seldom, make this connection. A long-haul flight emits approximately 1 ton of climate change gases per person. That’s one-tenth of the average carbon footprint of a person in the UK. Tourism is really about transportation, consumption tourists usually use more resources than the locals, changing the natural habitat, and denying local people access to areas such as beaches that are fenced off for tourists.”

Pamela Nowicka is the author of the book, ‘The No-Nonsense Guide to Tourism’ and she accepts that she understood more about tourism only while doing research for her book. According to her, most people from West consider holidays as their privilege and they are unaware of the impacts caused by travel on others. The book was made a film in which she shows people as to how excessive consumption of resources is denying other people

even the most basic things such as water. Although most of the governments are contended about generating revenue through foreign exchange, it is actually the local people who suffer from the damages caused by tourism.

Ever since 2009, there has been a constant increase in the arrival of tourist across the world. Transport is increasing, by all means, say air, rail, and roads. According to data facts, there were 1.186 billion tourist arrivals worldwide in the year 2015. The mode of travel chosen by tourists is shown below (Figure 6.4).

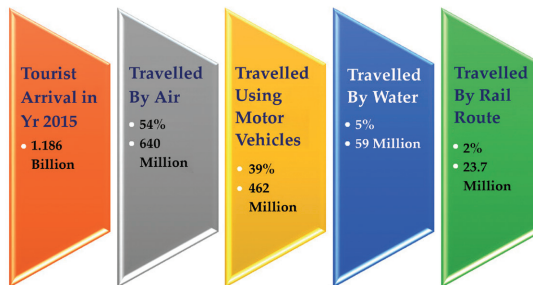


Figure 6.4: Modes of transport preferred by tourists in year 2015.

From the Figure 6.4, it is clear that people prefer air travel largely. The emission of Carbon dioxide is more when it comes to transportation through air. For example, a seven-hour journey on a Boeing 747 flight produces 220 tons of carbon dioxide which is the amount of energy required to run an average family for 17 years. Similarly, an economic class flight from Singapore to Kuala Lumpur generates 30 kilograms of carbon dioxide per passenger. The growth of tourism industry leads to increase in gas emission. Due to the increase in the number of airports and the low cost of flights, people take up flight travel very easily.



Figure 6.5: Plane emitting greenhouse gas, (Source: <https://greenhousepr.co.uk/can-you-be-an-environmentalist-and-fly/>).

The analysis of air transportation shows that 80% of all the flights are used for carrying passengers who are traveling on holidays to different destinations (Figure 6.5). The international tourist arrival is on the increase. In 2010, there were 940 million international arrivals. It is expected that this count may increase to 1.6 billion in Year 2020 and 1.8 billion in 2030. Because of the increase in the number of airports, the travel duration is decreasing and so the number of trips offered by the aviation industry is increasing. The emission from air travel is expected to triple by the year 2035.

When Carbon dioxide emission increases, the global temperature level increases and it will be very hard to control the temperatures under 2°C. The world may follow the same trend in the future also and if it happens so then, Year 2100 will see air transport to be as nine times more than what it was in 2015. An increase in air travel will increase Carbon dioxide emissions from a level of 50% in 2005 to 76% in 2100.

Also, some studies conducted states that if tourism business is to follow the current path, then by year 2050 the Carbon dioxide emissions would reach 3 billion tons which is an unimaginable increase of 135% comparing today's emissions. If the climate change needs to be controlled, then we need to maintain the temperature increase below 2°C and in order to achieve this, the emission level needs to be kept at 70% until year 2050. Air transportation is responsible for majority of air emissions. A study conducted revealed that a single transatlantic return flight emitted nearly half of the Carbon dioxide emissions that was produced from all other sources like car, heating, lighting, etc., used by an average person for a year.

Traveling by Cruise ships to tourist destinations is also becoming quite common these days. As per the report from UN, emission of greenhouse gases from ships is responsible for 4.5% of global warming. IPCC predicts that this percentage will increase by 30% in 2020. The expansion of cruise tourism does not offer any benefit to the destination locations (Figure 6.6).

Tourism is blamed for contributing to climate change because the accumulation of greenhouse gases leads to rise in global temperature. These gases heat up the Earth and the process is called global warming. The Oceans are becoming warmer and Carbon dioxide dissolving in oceans is causing ocean acidification and creates many damages to the coral reefs and other species. Many other extreme occurrences like floods and hurricanes are also the chain reactions of increase in greenhouse gases and the following climate changes.



Figure 6.6: Emission from cruise ship, (Source: <https://www.timesofmalta.com/articles/view/20161218/environment/Project-aims-to-cut-air-pollution-from-ships-in-the-Mediterranean.634222>).

6.1.2. Depletion of the Ozone Layer

Quite often we hear many rumors as well as real data facts of the Ozone layer that worries people of this planet. Ozone layer is found in the Stratosphere which is the uppermost layer of the atmosphere and it acts as a protective shield to Earth. The Ozone layer absorbs the harmful ultraviolet rays coming from the Sun which are very dangerous to human beings and animals. According to scientists, there has been a decrease in the amphibian population because of the continuous exposure to Ultraviolet rays.

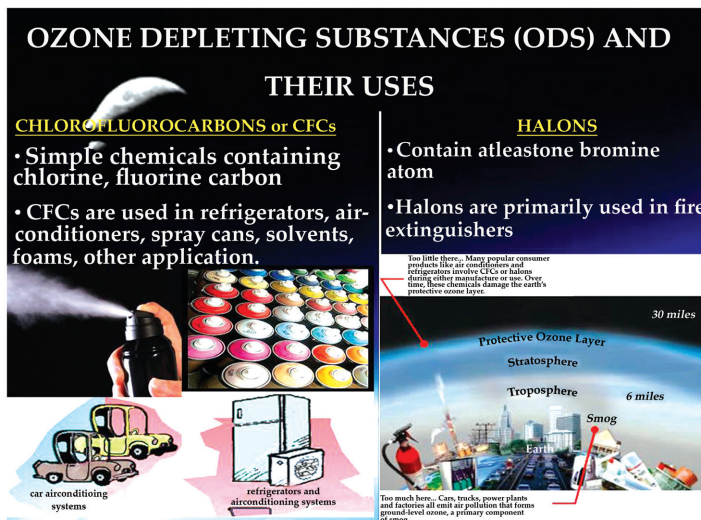


Figure 6.7: Ozone layer depleting substances, (Source: <http://slideplayer.com/slide/1424546/>).

Chemical substances such as Chlorofluorocarbon (CFCs), Hydrochlorofluorocarbons and halons deplete and damage the Ozone layer. The tourism industry indirectly contributes to the emission of these Ozone Depleting Substances (ODS). For example, the air conditioners, refrigerators, and propellants in aerosol spray cans used in hotels and resorts contain many ODSs. Jet aircrafts used for travel in tourism industry is also a significant contributor of ODSs. Most of the damage caused in Ozone layer is because of the increased air transportation (Figure 6.7).

6.1.2. Pollution

Tourism is no less compared to other industries in causing pollution. Noise pollution, air pollution, water pollution and pollution in each and every essential element are one of the major negative impacts of tourism which indirectly has effect on the environment and on the climate (Figure 6.8).



Figure 6.8: Pollution causes global warming, (Source: <https://www.slideshare.net/rachelkcole/global-warming-75954963>).

The continuous movement of vehicles carrying tourist from one place to another causes noise pollution. The generators used to compensate power cuts also produce more noise. Noise pollution causes animals to change their natural activity patterns. Here's a perfect example of impact caused by noise pollution: During winter 2000, 76,271 people entered Yellowstone National Park on snowmobiles, outnumbering the 40,727 visitors who came in cars, 10,779 in snow coaches and 512 on skis. A survey of snowmobile impacts on natural sounds at Yellowstone found that snowmobile noise could be heard

70% of the time at 11 of 13 sample sites, and 90% of the time at 8 sites. At the Old Faithful geyser, snowmobiles could be heard 100% of the time during the daytime period studied. Snowmobile noise drowned out even the sound of the geyser erupting. The emissions caused from transport causes air pollution which leads to global warming and cause extreme weather events like acid rain, etc.,

The growing tourism industry requires infrastructural development. More resorts and hotels are constructed to accommodate the increasing number of tourists. The construction of these facilities produce more waste and most of the times, these wastes are dumped into water bodies polluting the water. When water gets polluted, every living being and even lands that depend upon it gets affected. Water pollution is mostly caused by coastal tourism. Tourists also play a role in polluting the water resources (Figure 6.9).

The discharge of oil in water bear any influence on global warming



Here we can see oil which has been rejected into the sea by an oil tanker. Every year many tons of oil is put into the sea and causes global warming

Figure 6.9: Water pollution causes global warming, (Source: <http://slideplayer.com/slide/8657237/>).

As most of tourist places glitter in light throughout the night, it causes light pollution which disturbs the feeding and reproductive behavior of various creatures in those places. Light pollution also contributes to climate change. We all know that smog is created by air pollution. But every night, a chemical called Nitrate radical (NO_3) cleans up the air and clears this smog. The uniqueness of this chemical is that it works only in dark as the sunlight and other lights destroys it. The air pollution is very high in tourist destinations compared to other places and these places always glow in light

to attract tourists. These lights may be ten thousand times dimmer than sunlight but it has the same effect and so the pollution in air remains in the atmosphere.

6.1.3. Dumping of Garbage and Deforestation

When the tourist flow increases, there comes more demand for food and other essentials. When the supply of food and beverages increases, naturally there will be more wastes. Usage of plastic cups and non-biodegradable products are very harmful to the environment. Waste management mechanism is not fully functional in many of the remote tourist areas and this causes serious problems. For example, tourists going for trekking and mountain climbing leave their oxygen cylinders and other camping equipment in the mountains. This contaminates the environment when it is not cleared off properly. The amount of garbage found in the trails in Peruvian Andes and in Nepal left by tourists has led to the place being called as ‘Coca-Cola trail’ and “Toilet paper trail.’ Due to numerous construction activities, forests are being cut for want of wood and other raw materials. The reduction of forests has adverse effects on the environment and the ecological system. Many animals and species lose their habitats and more importantly reduction in trees has a drastic impact upon climate. Sea erosion takes place because of the destruction of the mangrove forests. A big village named Satabhaya in the coastal districts of Odisha, India got completely washed away only due to the removal of Mangroves along the coast of Bay of Bengal. Also, it is for the same reason that the Super Cyclones of 1999 killed more than 10,000 people in Odisha (Figure 6.10).

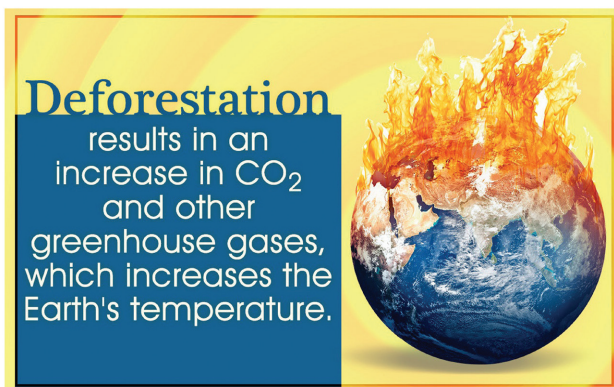


Figure 6.10: Impact of deforestation upon climate, (Source: <https://helpsav-enature.com/global-warming-deforestation>).

Moreland is accumulated to develop tourism industry by building infrastructure, hotels or recreational facilities and this is the main reason for deforestation to happen. Also, trees are being cut for collection of wood which is used as fuel. Tourist organizations planning to start trekking activities clear the forests in order to develop their business.

6.1.4. Shortage of Natural Resources and Fall of Biodiversity

Tourism has many negative impacts; excessive use of natural resources is one among them. Water is one of the most critical natural resource. It is very hard to get drinking water in many parts of the world. Very big hotels and resorts in general overuse water for swimming pools, golf courses, spas and for personal use of customers. In order to satisfy the tourists, the available natural resources are used in abundance making the locals to suffer.

Tourists coming to warmer regions drink more water due to the hot climate. They may not consume this much water in their home countries. Excessive use of water leads to water shortage and degradation of water supplies especially in areas where the resources are already scarcely available. Excessive withdrawal of groundwater may lead to sinking of lands. In particular, the demand is more during peak seasons (Figure 6.11).



Figure 6.11: A view of Myrtlewood Golf Club PineHills Course, (Source: <https://www.myrtlebeachgolftrips.com/courses/show/myrtlewood-pinehills>).

Golf course, in particular, requires enormous of water for its maintenance every day. As per data analysis, an average golf course in Thailand uses 1500 kg of chemical fertilizers, pesticides, and herbicides per year and it uses water that can be used by 60,000 rural villagers. Coastal wetlands are often drained and filled due to lack of more suitable sites for construction of tourism facilities and infrastructure. Soil erosion is the result of sand mining for construction of tourist facilities like restaurants and other recreational

facilities. These activities can cause severe disturbance and erosion of the local ecosystem, even destruction in the long term. Also, huge volumes of water are turned into waste.

Tourism also impacts biodiversity. Biological diversity refers to the various kinds of species living in this Earth. Natural tourism is closely associated with biodiversity. The main aim of people choosing natural tourism is to see the unique species that are in existence and that cannot be seen in their home country. The stress caused by human beings affects the ecological balance and thereby affect the biodiversity. When land and other resources are used in excess, it impacts the vegetation in that particular place leading to behavioral changes among the wildlife (Figure 6.12).



Figure 6.12: Tourism sector and biodiversity, (Source: <http://tourismplanning-professionals.com/?p=344>).

Tourists can bring in species that are not native to the local environment and that can cause enormous disruption and even destruction of ecosystems. Beautiful tourist attractions such as beaches, lakes, rivers, mountains, slopes are all having rich ecosystems. The ecosystems which is under threat of tourism are the alpine regions, mangrove and rain forests, wetlands, coral reefs and seagrass beds and any damage to these will have either direct or indirect impact on the climate.

6.2. TOURISM: MERELY SEEN AS A MONEY MAKING TOOL

Tourism industry is playing an important role in many developing nations. This industry creates jobs for millions of people both directly and indirectly. In some countries, tourism is the main source of income generator. Even rural areas get benefitted from tourism industry since it provides opportunities for small-scale business entrepreneurs. The tax revenues generated out of tourism is used for developing infrastructure, building of schools, colleges, hospitals, etc., (Figure 6.13)

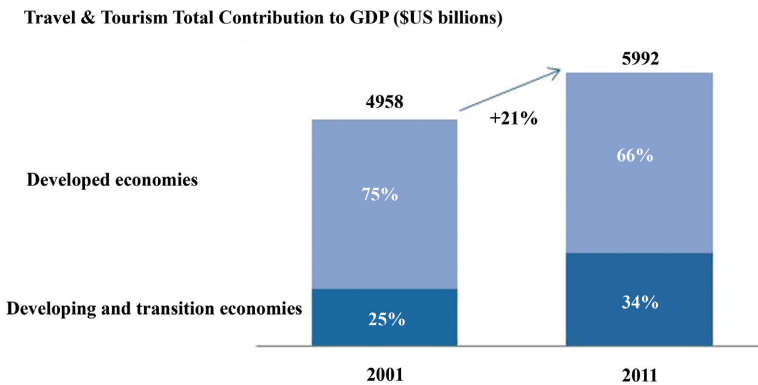


Figure 6.13: Travel and tourism total contribution to GDP, (Source: <http://blogs.worldbank.org/psd/should-we-be-promoting-tourism-sector-investment>).

In countries like Costa Rica, the majority of its national monetary reserves are based on tourism. Tourism brings in many social and economic benefits to the communities. This is the main reason for tourism industry to grow although it has many negative impacts. We all know that tourism contributes to air pollution. Even the tour operators are well aware of this. But the tour operators are more concerned about the satisfaction of tourists who help grow their business rather than the wellness of the environment. For example, tour buses that are operating in extreme hot or cold countries leave their motors running for hours even when the tourists go out for sight-seeing because they want the temperature in the bus to be perfect when the tourists return.

Tourism is a billion dollar industry.

- In Washington State, wildlife viewing is worth \$1 billion.

- In British Columbia, wilderness tourism generated \$1.5 billion in direct and indirect spend and supports 2200 businesses.

This shows the value of tourism industry and why it is considered only as a money making tool even discarding climate change impacts which affects humans and all other species as a whole.

6.3. DIFFERENT TOURIST ACTIVITIES AND THEIR IMPLICATIONS

Tourism does not start and end with just visiting places alone. People love to tour because of the numerous physical activities that they can engage in. Activities like kayaking, trekking, hiking, surfing, snorkeling, scuba diving, etc., provide much entertainment to the tourists but these activities affects the local ecology which indirectly impacts climate. In this section, we will look at various activities and how they affect the ecosystems.

People who choose trekking and mountaineering mostly use the same trail repeatedly. When they walk on the same trail again and again, they stamp on the vegetation and underlying soil and eventually cause damage to biodiversity. Continuous trekking in these areas leads to erosion of soil itself. There are mountaineers and hikers who are involved in the activity for many days and so they camp at night either informal or random campgrounds.

The Campgrounds also face similar impacts like soil compaction, erosion, and composition, loss of vegetation and foliage, plus the additional issues of campfires for cooking and warmth. The heat of campfires may damage tree-root systems. Informal campgrounds, tent pad areas are normally devoid of any vegetation while random camping can damage sensitive plants and grasses during a single overnight stay.

Skiing is the favorite sport for many tourists but skiing causes severe erosion and deforestation. The activities that are not in sync with nature will definitely harm the environment and will cause climatic impacts.

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CHAPTER 7

BUILDING A CLIMATE FRIENDLY TOURISM BUSINESS

“Our goal is to fundamentally change the way the world uses energy... we want to change the entire energy infrastructure of the world to Zero Carbon.”
—Dr.Vandana Shiva

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Tourism industry is flourishing at a rapid speed. Although tourism industry is blamed to be one of the significant contributors for climate change, tourism cannot be completely avoided or one cannot keep a blind eye on it because of its negative impacts. In order to continue tourism without harming the nature, climate friendly tourism is the only way. Eco-friendly tourism, sustainable tourism, etc., are some of the names given to different types of tourism in which various adaptive measures are followed to preserve the environment and thereby does not interrupt the climate. In this chapter, we would discuss in detail about the different ways in which tourism business is turning into climate friendly business. Also this chapter will focus on the roles and responsibilities of tourists and how a responsible tourist should be. We will also look at some of the eco-friendly tourist destinations that are popular among tourists today.

7.1. CLIMATE FRIENDLY TOURISM: DEFINITION AND MEANING

All of us must have known about the different types of tourism that is in existence and which caters to the needs of tourists. Among the various types of tourism, the most important one and which is very much essential for today's world is climate friendly tourism. Since most of the nations as well as common people have started to recognize the importance of climate change and the impact of tourism on climate, the millennials largely are opting for tourism packages that are climate friendly. As the demand for climate friendly tourism increases, the tour operators promote such packages labeling it under different names, out of which 'Sustainable Tourism' and 'Eco-friendly Tourism' are the most popular and preferred ones.

Every human being has seen the harsh impact of climate change and is experiencing variations in climate almost on a daily basis. They now understand the importance of nature and worried about their future generations. They realize the ill effects of modernization and how the latest technologies have changed their own lives as well as the society. People are very much eager and willing to adapt to any measures that may reduce the negative effects brought by modernization. So when tourist companies offer packages that emphasizes on 'Go Green' policy, the tourists are very much attracted to it as they get a satisfaction of contributing to their planet. This is where eco-tourism and sustainable tourism comes into picture.

The International Ecotourism Society defines *Ecotourism* as "responsible travel to natural areas which conserves the environment and improves the

welfare of the local people.”

Sustainable tourism has been defined as a type of tourism that incorporates the principles of sustainable development, i.e., considering not only the economic but also the social and environmental bottom line.

Both these types of tourism evoke environmental awareness among people. The tourists have seen by themselves as to how the natural calamities take the lives of thousands of people. These are all the ways by which the environment reciprocates to the injustice done to it by humans. Through ecotourism, people can be educated on the importance of environment. Eco-tourism is gaining popularity among tourists around the world. This is due to the initiatives taken by the environmentalists. The International Ecotourism Society defines ecotourism as “responsible travel to natural areas which conserves the environment and improves the welfare of the local people.”

Climatic impact occurs when tourists disturb the nature’s most valuable resources like mountains, hills, rivers, oceans and forests in the name of tourism. Hence, eco-tourism is promoted mainly in these regions in order to make the adventure activities climate friendly. Many countries depend on tourism as their main source of income and these countries have to protect their greenery in order to be on top list. As each and every tourist activity has an impact upon the environment either directly or indirectly, the government needs to be extra cautious and take additional measures in order to preserve the environment because even a minute change in the ecosystem has an effect on the climate.

In a Climate-friendly tourism business, products and services are chosen in such a way that nature is not harmed in any way in the tourist destinations. There are many definitions laid out for eco-tourism. Some of them are listed below:

- Eco-tourism also means traveling to the less famous and less developed tourist destinations in order to help the locals over there and to provide funds for the development of the tourist spots.
- Eco-tourism entertains an avid tourist in such a way that it is minimally intrusive to the environment and only helps in the betterment of the environment.
- Ecotourism is responsible travel to natural areas that conserves the environment and sustains the well-being of the local people.

It is only with the support from tourists as well as the service providers that eco-tourism can become successful. Eco-tourism or the climate-friendly tourism is much needed in today's world. People love to visit places that are rich in flora and fauna. Eco-friendly tourism promotes practices that add value to the environment. Eco-tourism is mostly chosen by nature lovers and the best way to attract them is by having environment preservation as the USP of that particular tourist destination. This type of tourism not only increases the number of tourists but also creates a global image to that particular destination.

Our planet Earth has abundant natural resources. Right from the rich wildlife of Asia and Africa to the extra-ordinary coastal regions of the Caribbean's, we can see the best of God's creation in this planet. Rather than places with outstanding infrastructure, eco-tourism prefers more peaceful undiscovered locations which symbolize nature in its own form. As more and more people travel to a particular destination, the place loses its natural value and that is where the importance of eco-tourism is felt.

Let us now see how eco-tourism or climate-friendly tourism can be applied in various tourist related –activities:

- i. The first and foremost negative impact of tourism is the pollution caused by it. Travelling by means of planes and boats will pollute air and water and this in turn affects everything that consumes it. To practice climate friendly tourism, people can travel using coracles and still enjoy the beauty of the place. Coracles are used in water and it can hold upto four people and the main advantage is that it does not cause any kind of pollution.
- ii. In the earlier Chapters, we have seen how resorts and luxury hotels dump garbage and waste into water bodies and destroy the water bodies. Also in order to satisfy the customers, they procure water and other resources in large amount from nearby areas and disturb the natural habitats of many other creatures. In order to avoid this irresponsible corporate behavior, tourists can look to opt for guesthouses run by local people. By choosing this, the tourists are benefited as they need not spend more money on hotels and they also help the locals economically and most importantly they safeguard the resources.
- iii. Solid wastes and garbage should not be thrown on the streets; instead dustbins are to be used.
- iv. Instead of using private taxis every time, tourist buses can be

used as it can reduce air pollution. Use of bi-cycles and renewable sources of energy are promoted.

- v. The best method for adapting climate friendly tourism is to avoid using plastics. It is a well-known fact that plastics take a million years to degrade and is a major cause of pollution and contamination of tourist destinations. Instead of buying disposable water bottles or packets, it's always good to carry our own water bottles and refill them whenever needed. Having food in earthen vessels and degradable paper plates whenever possible helps sustain the ecosystem and the climate.
- vi. Stressing upon water conservation and use of recycled products are given importance in climate friendly tourism.
- vii. Water, energy and other raw materials must be used efficiently. Conservation of environment must be the main motto of the trip.

In order to minimize the adverse impacts of tourism on the environment, United Nation Environment Programme (UNEP) and United Nations World Tourism Organization (UNWTO) through their joint efforts launched 2002 as the ecotourism year. Many kinds of nature tourism pop up every now and then. But all nature tourism types cannot be called eco-tourism. Ecotourism is possible only in such nature-based locations where there are possibilities of low impact on the surrounding environment or natural resources.

Even eco-tourism has its own limits and restrictions; if not followed properly it may damage the attractions. Few examples of places where eco-tourism is followed strictly – Ecuador, a Latin American-based country is one of the most exciting countries in the world working on ecotourism for community development. The Annapurna Conservation Area in Nepal is famous for socio-cultural biodiversity and receives over 50,000 trekkers annually.

Many tourist operators and agencies are promoting their business by just tagging the label as Eco-tourism. By using 'Go Green' tag line, they in fact charge the customers more and the tourists also pay the amount as they want to contribute their share to the environment. According to some research, travelers give priority to companies that embed green or eco-friendly practices in their operations. But the tourists have to be very sure as to whether the service operators are really keeping up their word or are they just using eco-tourism only for marketing purpose to attract more customers. Many tourist companies although they desire to go with eco-tourism, they are unable to live up to the expectations and standards since a hell lot of

money has to be invested to set up the infrastructure that would comply with the environmental needs and most of the organizations lack this capital.

Eco-friendly tourism can be promoted in a number of ways if every individual is educated on this concept and are made aware of their role in sustaining eco-friendly tourism. Every human being should understand that the environment belongs to us and we are fully responsible for whatever changes it undergoes. It is said that more than 80% of the Europeans are concerned about the loss of bio-diversity. Climate-friendly tourism or the eco-tourism emphasizes the role of environment and eco-system in altering the climate. This type of tourism can change the mindset of people and will take the tourism industry to the next level safeguarding our planet.

7.2. ADAPTING SUSTAINABLE TOURISM

Climate change is a global phenomenon that changes the shape of tourism. Climate is very important for the tourism business to thrive and tourism also contributes to the climate change. Hence in order to lower the impact of tourism on climate, some mitigation has to be followed. Practicing Sustainable tourism is one of the ways by which a climate-friendly tourism business can be laid out.

As tourism industry is flourishing rapidly in many countries, it causes significant impact on natural resources, consumption patterns and also causes pollution which is the basis for the existence of life. This is the reason for the urgent need of sustainable/responsible tourism. If the tourism industry needs to survive, then, sustainable tourism must be brought into picture.

What is Sustainable Tourism?

It is a type of tourism that respects both local people and the traveller, cultural heritage and the environment. Sustainable tourism intends to provide people with an exciting and educational holiday that also benefits the people of the host country.

Sustainable tourism is common for all; be it holiday trips, business travels, adventure travels, travel for conferences, etc., There is not much difference between sustainable tourism and eco-tourism; both has similar concepts but sustainable tourism is broader in category as it covers all types of travels and destinations. Let us look at some of the environmental impacts caused by tourism and other factors and understand why sustainable tourism is required (Figure 7.1).

- Ever since 1970, one third of the nature is destroyed by human activity and almost two-third is degraded by humans.
- Every year some 40 million tons of Carbon is dumped into the atmosphere.
- Even though 70% of the earth's surface is covered with water, only 3% is drinkable and even that is being polluted by throwing garbage into it.
- The number of cars used in roads has gone upto 1 billion in year 2010 and today it has become 1.2 billion and it is estimated that this number will go to 2 billion by year 2035.
- The Bellagio hotel in Las Vegas is said to recycle its water but still it uses 12 million liters of water per year that too in a region where water is scarce.
- The Mayan Riviera is being visited by almost ten thousand people every day but this destination has not done anything for recycling of used goods which if installed can save a lot of energy.
- The comparative analysis of water usage has revealed that an average Canadian household uses 326 liters of water per day; a village with 700 people in a developing country on an average uses 500 liters of water per month and a guest in a luxury hotel room uses 1800 liters of water per person per night. This reveals that the tourists staying at hotels and resorts use resources excessively.
- Beef eating is the most water consumptive practice followed by many travellers.
- 35% of the mangrove forests have been destroyed.
- The world's Coral Reefs are highly at risk and according to reports more than 90% of the coral reefs will die by 2050.
- 70% of the marine mammals are under threat.
- By 2050, half of the Amazon rainforests will vanish due to climate change.

Figure 7.1: Environmental Impacts Caused by tourism and the need for sustainable tourism, (Source: *World Resources Institute Reefs at Risk*, 2013, *WTO*, 2000, & 2002, *UNWTO*, 2015, *NCDC*, 2015, *www.risingtide.co.uk*, 2004, *UN*, 2003, *Gov't of Canada*, 2005, *Tourism Concern*, 2011, *Green Car Reports*, 2014, *Science Museum*, 2010).

Sustainable tourism looks into every aspect such as social development, environmental conservation and economy of the host destinations. It re-focuses on each aspect and the contribution made by sustainable tourism to nature is immense. Few examples of sustainable business practice model are given in Figure 7.2.



Figure 7.2: Business practice model of sustainable tourism.

Sustainable tourism business normally cuts down its own costs in order to preserve the longevity of its business. But the fact is that such a system cannot continue for long. If a business model needs to survive then it must be profitable to the business owners. Tourism management and planning of resources in sustainable tourism is beneficial to the universe as well as the stakeholders. It is said that 1 acre of trees absorbs 2.6 tonnes of Carbon dioxide per year. Sustainable tourism is growing at a rapid speed; whether it is the zero-emission hotel in Milan where toiletries are 99% biodegradable, or Gaansbai in South Africa, where conservation of native flora and fauna is a community-wide priority.

Many efforts have been taken by entrepreneurs and tourist companies globally to spread sustainable tourism and it is for this fact and to celebrate the spirit, the United Nations marked Year 2017 as the International Year of Sustainable Tourism for Development. Sustainable tourism is an opportunity for every traveller who is worried about the recent climatic trends and who wishes to give something back to the society and the universe. The year 2017 was marked with the campaign of ‘Travel.Enjoy.Respect’ which aimed at emphasizing the role of the traveller in amplifying the potential of tourism without causing any damage to the environment.

As the tourism industry is growing, it is estimated that the number of tourists globally will increase to 1.6 billion by 2020 and there will be no slow down in the numbers. The green house gas emissions will continue to increase from tourism business. According to UN Environment, the proportion of green house gases will be higher at the rate of 12.5% considering the energy used at hotels, for transportation and toiletries. Water consumption will increase. It is noted that a tourist in Europe will consume more water on a holiday than at his/her home. Luxury hotels spend more water for swimming pools and golf courses. Resorts and cruise ships generate a lot of waste.

In order to achieve Sustainable Development Goals, a massive change in tourism is required. This can be achieved only with the help of tourists. Only tourists will be able to reduce the impact that they create on the environment. How can the Sustainable Development Goals be achieved? There can be hundreds of different sustainable tourism standards to choose from. The Global Sustainable Tourism Council has a reliable guide, and maintains recent sustainability criteria for hotels, destinations and tour operators. Try to find answers for the point mentioned in Figure 7.2. This way the tourists can be assured that the money that they are spending is for sustainable tourism.

As we know air travel is the main mode for carbon emission, buying carbon offsets is the best way to reduce the impact when flying. The UN Climate Convention's Climate Neutral Now provides advice and ensures that offsetting generates real and positive benefits. The International Year of Sustainable Tourism for Development advises tourists to consider the impact of their travel on sustainable economies, societies, environments and cultures. Choosing sustainable tourism will make one create more than travel memories. We will not only be contended with the time spend but also with the way in which it is spend. We gain self-respect as we have the feeling of helping our planet to be green and clean. This can only be possible through Sustainable tourism.

7.3. BENEFITS OF ECO-FRIENDLY TOURISM

We have seen a little of what eco-tourism means in the earlier sections of this Chapter. Now we will learn more in depth about eco-friendly tourism and the various benefits derived out of it. Under eco-tourism, people love to travel to places that are rich in natural resources and principles of eco-tourism encourage the tourist to preserve and conserve the nature. Eco-tourism stresses the need on safeguarding the environment and makes it habitable for humans as well as other species. In doing so, humans have got a lot of responsibility. They have to take good care of their surroundings.

Eco-friendly tourism has become a part of environmental conservation and hence it is gaining more importance in tourism business. The International Eco-tourism Society states eco-tourism as, “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education.” Ever since 1980, eco-tourism is considered as a critical endeavor by environmentalists so that future generations may experience destinations relatively untouched

by human intervention. Eco-tourism is designed in such a way that it takes over the negative aspects of conventional tourism.

Many countries have been forced to take up eco-tourism. Dynamiting and mining of corals for building materials has become a common practice in Philippines and Maldives. Inadequate sewage treatment along the coastline of Brazil is contaminating the quality of water in beaches and lagoons. Extensive trekking expedition in Nepal has led to the destruction of mountain treks and trails. Increase in the safari activities in Kenya has decreased the wildlife activities. All these have supported the emergence of eco-tourism with the belief that eco-tourism is capable of making dramatic changes.

According to The International Ecotourism Society (TIES) definition, eco-tourism has the following characteristics (Figure 7.3).



Figure 7.3: Characteristics of eco-tourism.

Eco-tourism is seen as an effective tool which will protect the Earth from destruction. Human beings are exploiting nature in the name of development and this has resulted in global warming and pollution which impacts the climate. However eco-tourism has emerged as a boon to save nature, from destruction caused by tourism.

Eco-tourism is helping nations in different ways. Other than generating revenue, it also helps in educating people on the importance of preserving the environment. Eco-tourism can also be called responsible tourism as it promotes recycling and conservation of resources. This tourism insists the need to protect the environment by creating national parks, wildlife preserves and marine parks. Eco-tourism has started gaining momentum and due to its enormous benefits, many international hotels, tour operators and tourist

organizations have started to adopt the principles of eco-tourism.

Let us now discuss some of the benefits of eco-tourism in detail.

7.3.1. Eco-tourism Reduces Environmental Impact

When tourists are made aware of the positives of eco-tourism, they will choose eco-travel services that will have less to no impact on the environment. They will also look for different ways in which they can contribute to preserve the natural environment. There are many tourist attractions that are insensitive to the environment and other species. These destinations continue to attract a large number of crowds and make a lot of money. Tourists also spend a lot of money to visit these attractions, unaware of the harm they create to the environment and how it affects the climate. But once these people are educated about the wellness of eco-tourism, they will readily skip their luxury and contribute to the spread of eco-tourism. They will have a lot more satisfaction as they have helped the planet and the people to lead a long healthy life.

7.3.2. Eco-tourism Helps in Reducing Carbon Footprint

There is no tourism without travel. Commuting is a major part of the tourism industry and this leads to carbon emission in the atmosphere. As commuting is unavoidable, eco-tourism looks into ways by which it can cut back on pollution. It promotes unique types of travel such as using shared transportation which will result in less Carbon release and also transport by foot wherever possible.

Benefits of Eco-tourism in Cruise Industry.

Today people are well aware and worried about the footprint that they might leave after visiting their holiday destination. Choosing cruise travel has become a trend in today's world. Since cruise ships are considered to be one of the biggest polluters, eco-tourism is very much needed in this domain. A cruise ship is said to generate 15 gallons of hazardous chemical waste per day. According to the data facts from Friends of the Earth (FOE), a cruise ship generates 2,137 lbs of Carbon dioxide per passenger and the ocean-going vessels discharge about 100 million gallons of petroleum in the ocean every year. Many complaints are lodged against the cruise ships for its way of waste management. The Cruise Line industry was accused by FOE for 'green washing to hide its dirty practices from the public and refusing to disclose the information on their operations.' But there are some cruise

ships that have adapted some green initiatives like cutting-edge emissions offsetting technologies to their credit. Peace Boat Eco-ship project is one such example (Figure 7.4).



Figure 7.4: Peace boat's ecoship project, (Source: <https://www.ship-technology.com/features/featurewaking-up-to-the-benefits-of-eco-friendly-cruise-trips-5783681/>).

Peace Boat is an initiative of Japan based international non-governmental and non-profit organization and the Peace Boat is travelling the world with the sole purpose of promoting peace, human rights, equal and sustainable development and respect for the environment. The next aim of this organization is the Eco-ship project which incorporates a combination of factors and renewable technologies. Using the expertise knowledge of marine engineers, maritime law, naval architects, experts in renewable energy, biomimicry and biophilia, they have guaranteed a 40% reduction in the Carbon dioxide emissions compared to the conventional cruise ships.

The US Disney Cruise Company stood out among 17 cruise line companies for its transparency regarding its environmental efforts. This was the only cruise provider to receive an A certification on FOE's 2016 Cruise Ship Report Card. Ever since year 2011, the US Cruise Line has donated more than 60,000 gallons of used cooking oil to Bahamas Waste Management, who turned it into biodiesel that fuels a fleet of vehicles in Nassau. Disney Cruises follows many recycling practices that make it stand top of all other cruise ships in contributing to the environment. In Disney Cruises, the laundry uses water that is generated from the air conditioning system which comes to 280 tons of water per day. Most of the materials from the ship such as aluminum and card board are recycled, and reusable objects and materials

are donated to the needy in port communities. Eco-tourism which is nothing but an environmentally friendly tourism satisfies every visitor. It re-ensures every visitors responsibility towards the environment. Eco-tourism makes it very clear that the nature should not be disturbed and it ensures the survival of the attractions of the nature and culture, without harming the resources. Eco-tourism is a sound environmental tourism, which is promoting nature travel as the hottest eco correct activity available.

Eco-tourism will yield many benefits when it is designed and managed by local people as they are the first victims of any environmental damage. Eco-tourism works on the principle of 'leave nothing but footprints.' As eco-tourism spreads, the need for a safe environment will attract everyone.

7.4. ROLE OF ECO-FRIENDLY TOURISTS

Tourism is impossible without tourists. The number of international tourists has increased from 25 million in 1950 to 1.2 billion in 2015. According to the United Nations World Tourism Organization (UNWTO), tourist spending increased from only \$2 billion in 1950 to \$1.2 trillion in 2015. The increase in the number of tourists is a trend not only in international tourism but also in domestic tourism; when compared to international tourism, domestic tourism is even bigger. It is said that almost 5 to 6 billion people spend their holidays at home country. So everyone out there are tourists, in one way or the other.

According to a recent research conducted by the tour operator Thomson, the number of tourists opting for eco-tourism holidays is growing three times faster than those choosing mainstream trips and this is predicted to make up 5 % of the global holiday market by 2024. Due to the changing trend in the tourism patterns, the eco-tourists are classified into two categories – light green and dark green categories. Tourists under light green category are environmentally responsible but they put comfort over conservation whereas dark green tourists put conservation before comfort.

Below are some of the tips to be a climate friendly traveller:

7.4.1. Plan Your Travel to Nearby Destinations

Holidays are for us to relax and have fun. This can be achieved even if we travel to some nearby destinations. It doesn't need to be very far always. The advantage of planning a short trip travel is that tourist can use bicycles or bikes to travel rather than cars or planes which causes pollution.

7.4.2. Travel by Public Transportation

As eco-tourism is all about responsible travel to natural areas and promote conservation, one should keep in mind to use transport that emits less gas and has less impact on the environment. Europe is a great travel destination and high-speed trains are the best way to travel through Europe. There are many travel agencies which help in planning such trips. Many countries have good and efficient public transport systems and lots of tourist destinations have car-sharing practices for travellers (Figure 7.5).



Figure 7.5: Ferry across the Mersey Liverpool, (Source: <http://sconzani.blogspot.com/2014/09/england-liverpool-and-ferry-cross-mersey.html>).

The Ferries in UK not only takes one across most of UK but also to France and Scandinavia. This is one of the best ways to thank the environment and protect it. By using public transport, any extra carbon emissions coming from private transport can be avoided. Tourist will also be able to see the countryside more closely if they avoid flight travel.

7.4.3. Be Aware of What You Carry with You

It's always good to have re-usable shopping bags instead of plastic bags (Figure 7.6). It is said that plastic bags or any plastic items can take up to 500 years to biodegrade and it is not only harmful to the environment but also to the animals and plants. Ankit Choudhury, a cyclist who has travelled across the country states, "The amount of plastic waste on highways, hillsides and lakes is appalling. The worst is plastic." Tourists can avoid bottled water and carry re-usable water bottles with drinking water. Water filters are installed in many hotels and the travelers can make use of it to refill their bottles with safe water. According to Global Water Think Tank, The Pacific Institute,

bottles used to package water take over thousand years to bio-degrade and when incinerated, produce toxic fumes.

**REMEMBER YOUR
REUSABLE BAG!**



**No MORE
PLASTIC BAGS**



Figure 7.6: Picture representing use of reusable bags, (Source: <http://fijisun.com.fj/2017/07/29/plastic-bag-tax-not-so-good-for-makers/>).

An eco-tourist must be responsible in what he carries when flying. The amount of carbon emission increases depending on the weight of the plane. One can reduce the weight of the luggage by keeping in mind what he/she packs. The load of the baggage can be reduced by removing clothes that are not multipurpose and by downloading books on Kindle instead of carrying books to read. Packing lightly not only reduces the baggage but also helps in reducing the waiting time to pick up the luggage at the airport.

7.4.4. Treat Hotel as Your Home



Think.



Act.



Save.

SAVE THE ENVIRONMENT

**PLEASE SWITCH OFF THE
LIGHTS AND FANS BEFORE YOU
LEAVE.**

Figure 7.7: Power conservation at hotels, (Source: <https://followgreenliving.com/10-quick-ways-save-resources/>).

Most people's behavior changes when they stay in a hotel. They take everything for granted when they are provided with plenty of offers. To be an eco-tourism, one should act in a hotel like he/she is at home. They should try to avoid getting clean towels if it is not necessary; avoid taking lengthy showers and wastewater. The tourists can reuse the towels and sheets and also close the tap when not brushing the teeth. Many do not care about switching off the TVs, lights and air conditions when they leave the room. An eco-tourist should not have this kind of attitude.

7.4.5. Travel in Small Groups

Travelling in small groups is said to make less impact on the environment. Check on the group size before booking the trip. The more the number of tourists, more damage is caused to the environment. For example, the Thailand government closed three of its popular islands in the coast of Phuket because of the increase in the number of tourists and the negative impact caused by it. They also closed one of Thailand's National Parks because of damages in the marine ecosystem such as coral bleaching.

7.4.6. Check Authenticity of Products

Not all companies advertising eco-friendliness are genuinely eco-friendly. Many companies trick customers to buy products or even choose hotels, airlines, cruises that are not eco-friendly. It is always good to check for third-party certification if the goal is to support eco-friendly products. Always choose companies that support local environmental issues. For example, if a travel is planned to Africa, then the tour operator must commend on water conservation. Tourist can choose the tour operators who use the best environmental practices in their tours. The growth of information and technology allows anyone to find data about any hotel. Many hotels' official websites will have information on how eco-friendly they are. The Global Sustainable Tourism Council has database of global vendors, hotels and destinations that follow certain sustainability standards.

We can also say whether a product is environment friendly or not just by looking at its label. Few such labels are mentioned below.

7.4.6.1. Energy Star



Figure 7.8: Energy star label, (Source: <http://trustinaplus.com/windows/>).

Hotels holding this label is said to be energy efficient. In order to receive this label, hotels have to submit their verified energy bills for review (Figure 7.8).

7.4.6.2. LEED



Figure 7.9: LEED symbol, (Source: <http://al-munaco.com/inspiration/green-products/>).

This label is provided by US Green Building Council to buildings and upgrades those that meet green requirements (Figure 7.9).

7.4.6.3. TripAdvisor Green Leaders



Figure 7.10: Green leaders logo, (Source: <https://www.turfvalley.com/green-practices.aspx>).

Hotels need to meet some minimum standards to get this badge like, some achievements in recycling or any reuse programs (Figure 7.10).

7.4.7. Choose Fuel-Efficient Airlines

Airlines emit highest amount of Carbon dioxide. Hence choosing an airline that is most fuel-efficient will help in reducing pollution (Figure 7.11). The most fuel-efficient domestic airline companies in United States are Spirit, Frontier and Alaska. World Bank studies reveal that the carbon footprint of a traveller flying in business class can be thrice as compared to the one travelling in economy class.



Figure 7.11: Biofuel Alaska, the most fuel efficient airline for seventh year, (Source: <https://blog.alaskaair.com/alaska-airlines/green/alaska-is-the-most-fuel-efficient-airline/>).

A first class travel contributes even more; it is nine times greater. Many airline companies now allow passengers to check their miles flown and many also allow passengers to donate miles to their favorite non-profit organizations like The Carbonfund Foundation and TerraPass. Louise Twining-Ward, CEO of Sustainable Travel International says every passenger to look into their frequent flier mile programs. As an initiative from tourists, they can also pay voluntary carbon tax whenever they fly. Many should start using Goodshop coupons to purchase anything from luggage to currency since a portion of what we spend is donated back to an environmentally-focused organization, like the Natural Resources Defense Council or Conservation International.

7.4.8. Eat Locally



Figure 7.12: Tourists having local food, (Source: <https://jordanecopark.wordpress.com/page/2/>).

An eco-friendly traveler will choose to eat and even drink beer locally as it will reduce the carbon footprint. When importance is given to local produce, import of food products from other parts of the world will reduce, thereby reducing transportation and finally carbon emission. Eating local cuisine is one of the best parts of touring. Even if you are an AirBnB traveller and cooking for yourself, you can grab fresh supplies from the local food markets. More than 92% of UK tourists have already started practicing this (Figure 7.12).

7.4.9. Avoid Contributing to Practices against Nature

Tourism consists of some activities that are carried out against nature, just for the sake of attracting customers. This does no good to the environment or to the tourist other than earning money for the tour company. An eco-friendly traveler should filter such kind of activities and should avoid participating in it. For example, people going for hiking should always stay on marked trails and stay away from animals; access areas that are allotted for visitors; otherwise the tourist may become a threat to the endangered plant and animal

species. An eco-friendly traveler must always respect nature's creation and should not become a threat to it. There are also many recreational activities where animals are tortured to showcase in front of tourists to earn money. It is better to avoid watching these and lose your money for it. Instead of participating in these events, one can try indulging in fun-filled outdoor activities like setting up a camp, relaxing under fresh air gazing at stars at nights and these activities does not have any carbon emission.

The above-mentioned points are some of the tips that every traveler can adopt in order to support the environment and safeguard Earth from any climatic disasters. Most tourist spots advertise the statement – 'Leave only footprints.' This should be the main goal of travelers in addition to their own enjoyment. Whenever and wherever possible, do not touch things and leave the place as it is. Avoid bathing or washing using chemical substances in the lakes and rivers. Many of us are not aware of how to start and where to start to become an eco-traveler. A thorough web search will provide information on many eco-friendly tour packages and as a responsible tourist, we can choose the ones that genuinely serves the purpose. If you are not satisfied with the contributions that you have made to the environment, you can alternatively check your hotels on any associated philanthropy programs to which they can donate.

7.5. TOP DESTINATIONS FOR ECO-TOURISM

We all know that many tourist destinations are being shut down for public view and many are also becoming extinct due to the irresponsible behavior of tourists. As eco-tourism is becoming more important than ever, eco-tourism destinations are also becoming more popular. Eco-tourism destinations not only offers visit to natural places but also ensures that the tourists behave responsibly. In this way environment is not disturbed and tourists are also happy.

Following are some of the top eco-tourism destinations in the world.

7.5.1. Kenya

Kenya is very popular among eco-tourists since it habitats five big creatures such as elephants, rhinos, lions, buffalo and leopards. Apart from these fierce animals, Kenya also has mountains, rain forests, lakes, deserts and beaches which is not known much to the outside world. 11% of the world's avian species are in Kenya (Figure 7.13).



Figure 7.13: Elephant pepper camp, Kenya, (Source: <http://sujanluxury.com/elephant-pepper-camp/>).

This place is a perfect example for biodiversity, specifically of birds. The wildebeests that migrate to the Masai Mara National Reserve every July and August can be found in Kenya. The country is preserving its natural diversity in its national parks. Though illegal poaching is prevalent in Kenya, the tourist organizations are working with their maximum potential to make sure that the travellers respect the eco-system. There are many other volunteer programs and arts and crafts workshop in Kenya arranged by the tourism department that the eco-tourists can participate. The Ecotourism Kenya keeps a watchful eye on all the tourist related activities in Kenya. This organization also rates lodges throughout Kenya based on their environmental policies.

7.5.2. Belize



Figure 7.14: The eco-lodge resort Chaa Creek in Belize, (Source: <https://belize-travel-blog.chaacreek.com/2013/12/year-ends-on-high-note-for-belize-ecotourism/>).

Belize is one of the few countries that contribute a lot to the conservation of wildlife and natural habitats. There are so many beautiful natural parks, eco-hotels and spectacular marine eco-systems. Tourists can also indulge themselves in scuba diving and look wild creatures in its natural habitats without disturbing them (Figure 7.14).

7.5.3. Canada



Figure 7.15: Moraine lake in Canada, (Source: <https://www.techflier.com/2016/08/14/7-tips-for-starting-a-sustainable-travel-or-ecotourism-start-up/>).

Canada has 36 national parks which is a treat for the eco-tourists. It also has the largest cross-border park in the world that covers more than one million hectares and reaches the Glacier Bay National Park in Alaska. Eco-tourists can enjoy trekking, iceberg rafting and bird watching (Figure 7.15).

7.5.4. Brazil

Brazil is the ideal place for eco-tourism with spectacular natural parks, pristine lakes and bird sanctuaries. Chapada Diamantina and the Abrolhos Marine national parks are worth visiting. Trekking, Camping and Canoeing are some of the activities that attract eco-tourists.



Figure 7.16: Iguaza Falls, Brazil, (Source: https://nl.123rf.com/photo_45341017_toeristen-bij-iguazu-falls-op-de-grens-van-argentin%C3%AB-brazili%C3%AB-en-paraguay-.html).

7.5.5. Costa Rica



Figure 7.17: Pacaure lodge in Costa Rica, (Source: <https://www.nathab.com/central-america/custom-costa-rica/>).

The country has got a lot of credit for its well-protected natural beauty. Eco-tourists easily get attracted towards Costa Rica since one-fourth of this South American country is covered with rain forests and it has coastlines on both the Caribbean and Pacific. This country has a mix of biodiversity with breathtaking volcanoes and pristine beaches. Misty cloud forests, thick rain forests, black sand beaches and rushing river offers outdoor activities for nature lovers.

Costa Rica literally means ‘Rich Coast’ and the riches indicate four active volcanoes, dense rainforests, hot springs, uncrowded beaches, the Amazon-like Tortuguero National Park with jungle lodges; and abundant wildlife,

from monkeys to sea tortoises. Many wildlife creatures like monkeys, crocodiles, sloths, jaguars, sea turtles and poisonous dart frogs are found in the national parks of Costa Rica. Many eco-friendly accommodations are also available for the tourists who wish to stay and enjoy the beauty of Costa Rica.

7.5.6. Palau



Figure 7.18: Crystal clear waters of Palau, (Source: <https://www.outdooraus- tralia.com/articles/Explore-paradise-Palau-05020>).

Palau, an island in the western Pacific Ocean is known for its beautiful untouched beaches and the country supports eco-tourism to a large extent. Palau Island is one of the world's foremost diving destinations. The sea here is crystal clear and there is a beautiful world underwater with more than 500 species of corals and some 1400 kinds of fish. We cannot believe there is such a place until we see it with our own eyes. The country safeguards its beautiful coral reefs and unique species of fishes by declaring most of the reefs area as no fishing zone (Figure 7.18).

Similar to the beauty of oceans, the land also has different range of forests which attracts tourists. The remote location of Palau in the westernmost corner of Micronesia is the main reason for Palau to be able to preserve its natural resources and prevent the damages caused by mass tourism. The Palau Conservation Society manages nearly two dozen conservation areas and encourages sustainable development to protect the islands' fragile ecosystems. In order to support eco-tourism, the country has initiated a Palau Project, part of Blue Planet United, which brings university students to Palau to learn about the island and make documentary films about the country.

7.5.7. Galapagos Islands



Figure 7.19: Sea lions found in Galapagos islands, (Source: <https://greenglobaltravel.com/7-important-life-lessons-i-learned-in-the-galapagos-islands/>).

The Directorate of the Galapagos National Park has implemented a visitor management system to ensure that the natural beauty is respected and the tourists remain responsible. About 97% of the Galapagos is protected by the Galapagos National Park Service where, the environmentalists and eco-tourists dedicate themselves in preserving the precious eco-systems (Figure 7.19).

The Galapagos Islands were declared the first ever Natural World Heritage Site in 1978 due to the unique and amazing fauna that captures tourists' attention. It has also been named a UNESCO Biosphere Reserve in 1984. It is said that visiting the Galapagos Islands is eco-travel equivalent of making a pilgrimage to Mecca. The tourists organization is so cool that it actually allows the visitors to swim with sea-lions and penguins but it doesn't allow jet-ski or to use flash photography.

7.5.8. Norwegian Fjords

Norway is an international leader in environmental policy and it has taken many measures to protect its coastline by regulating fishing, sealing, whaling and petroleum industries. Because of the various initiatives and due to its remote location, the country is able to preserve the pristine beauty of Norway's famous fjords with their snowcapped mountains, tumbling

waterfalls and crystal-clear waters. A wide range of wildlife including eagles, porpoises, seals and seabirds lives here (Figure 7.20).



Figure 7.20: Geiranger Fjord, Norway, (Source: <http://www.textbooktravel.com/explore/europe/norway/>).

7.5.9. Kerala



Figure 7.21: An Ecotourist spot in Kerala, (Source: <http://www.thehindu.com/news/national/kerala/ecotourism-blooms-in-konni/article7691405.ece>).

Kerala is a small state in India and is popularly known as ‘God’s Own Country.’ This tag name suits well for the place as the beauty of the place is undisturbed and divine. The state of Kerala is home to thousands of animal and plant species. The threat of deforestation has reduced to a large extent by the measures taken by the state government. In Kerala, one can see greenery everywhere they turn their eyes on. The tourist officials are encouraging environmentally responsible tourists to travel to Kerala and immerse in its mesmerizing beauty (Figure 7.21).

7.5.10. Alaska



Figure 7.22: Eco-tourism in Alaska, (Source: <http://blog.antilogvacations.com/2016/04/ECOTOURISM-A-STEP-CLOSER-TO-NATURE.HTML>).

Alaska is a well-protected ecotourism destination which is also referred to as ‘The Great Land.’ Eco-tourists love this place for the range of wildlife present here and for the soaring snowcapped mountains, sprawling tundra, and a remote Arctic north. Humpback whales, brown bears, lynx, sea otters, sea lions, bald eagles, and blue whales are just some of the species safeguarded here. Alaska has many national parks and glaciers; tourists can go for rafting, sailing in the glaciers and can involve themselves in many more activities (Figure 7.22). The beauty of Alaska is so unique that the environmentalists prefer to leave it untapped.

7.5.11. The Amazon



Figure 7.23: Eco-tourists travelling in the Amazon rainforests, (Source: <https://www.chimuadventures.com/blog/2016/10/sustainability-ecuador/>).

The Amazon rainforest is of vital importance as it produces 20% of oxygen needed for the Earth and is rightly called the “Lungs of Our Planet.” These dense forests support many species of plants, animals and birds. The stretch of the Amazon forests found in Brazil is the perfect spot for eco-tourists. The tourists can walk among the treetops in Bahia’s Atlantic forest, along a 66-foot-high suspension bridge and admire the different species and their sounds (Figure 7.23). The dark nights in the forests turns out to be a musical concert with symphony sounds under the big sky.

7.5.12. Blue Mountains, Australia



Figure 7.24: A view of the Blue Mountains, Australia, (Source: <https://www.bluemts.com.au/things-to-do/>).

Blue Mountains in Australia is a popular eco-tourism destination where tourists can isolate themselves from the busy city life. This site has been designated as a UNESCO World Heritage Site in 2000. The Great Blue Mountains spreads across some 550 square miles of valleys, swamps, narrow canyons and rocky outcroppings. The unique flora and fauna in these hilly mountains and the national parks will steal the heart of the eco-tourists. The tourists can indulge themselves in rock climbing, rappelling, canoeing, horseback riding and mountain biking. There are many eco-friendly lodges and cabins that provide accommodation to tourists (Figure 7.24).

7.5.13. Borneo



Figure 7.25: People involved in eco-tourism in Borneo, (Source: <https://www.orangutantrekkingtours.com/>).

There are so many attractive spots in Borneo that the tourists will go mad deciding where to go. The mangroves, the wetlands, the Slopes of Mount Kinabalu and the dense forest trails of the Bario Loop, the Sepilok Orangutan Rehabilitation Centre are some of the main natural attractions in Borneo. A stay at the award-winning Sukau Rainforest Lodge is a must, as the lodge is a self-sufficient hotel subsisting on rainwater and solar energy. The lodge also has fishing platforms, electric motorboats, bird- and wildlife-viewing decks and a 1,500-foot-long Hornbill Boardwalk – which affords stellar viewings of the resident elephants that stroll around the back of the lodge (Figure 7.25).

7.5.14. Botswana



Figure 7.26: Tourists enjoying a safari ride in Botswana, (Source: <http://post.jagran.com/ecotourism-helps-wildlife-conservation-efforts-study-1452324413>).

Botswana is known as the “jewel of Africa” as it offers natural beauty and a variety of wildlife. There are these wide-open plains of Savannah, sprawling deserts, transient lakes, riverine forests, lakes and salt pans. One can see leopards, lions, zebras, elephant herds, hippos, white rhinos and chacma baboons while going on safaris. A number of environmentally friendly resorts have come up along the Savannah making it easier for the travelers to enjoy the eco-friendly stay (Figure 7.26).

7.5.15. Dominica



Figure 7.27: A waterfall in the Island of Dominica, (Source: <http://www.bonvoyageurs.com/2014/08/21/dominica/>).

The island of Dominica is also known as ‘The Nature Island of the Caribbean’ and is located between Martinique and Guadeloupe. This island is one of the easiest choices among the ecotourism destinations in the Caribbean. This was the first country in Caribbean to have participated in Earth Check. This island also owns the title, ‘Whale-Watching Capital of the Caribbean’ as more than 40-ton whales often visit this island to socialize, mate and play. Tourists are assured of spotting a whale close by. Other attractions like boiling lake, waterfalls, etc., make Dominica a haven for eco-tourist (Figure 7.27).

7.5.16: Himalayas



Figure 7.28: Eco-tourism in Himalayas, Nepal, (Source: <https://hiddentraces.com/en/eco-tourism-in-nepal-community-trekking/>).

The landscape of the Himalayan Mountains found in Nepal varies from sub-tropical valleys to alpine forests. Rustic trail lodges give independent trekkers the option to hike and rest at their own pace. The Himalayas has some of the highest mountains on Earth and these are all covered with snow which attracts every visitor (Figure 7.28).

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CHAPTER 8

POLICIES AND PRACTICES TO MONITOR CLIMATE CHANGE AND TOURISM

“Climate change policy is about how we redistribute de facto the world’s wealth.”
—Ottmar Edenhofer

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As we all are aware, a small change in the climate has serious repercussions. Mitigation and adaptation to climate change are looked upon as a primary goal by the world leaders, environmentalists, and the general public. Many international conferences on climate change, agreements and policies are signed by various leaders in order to lessen the impact and make the world safe for future generations to live. This chapter exclusively talks about the need for monitoring climate change and the various initiatives taken by leaders across the globe to maintain the temperatures from exceeding the danger level. The chapter also highlights the practices carried out in the tourism industry to adapt to the changing climate. This chapter aims to prove the point that, although humans have caused much damage and planted the seed for climate change, they are now vigorously working on to fix the issue.

8.1. WHAT IS THE NEED TO MONITOR CLIMATE CHANGE?

We, humans, have an indisputable connection with weather and climate from time immemorial. Even when there was no science and technology, people used various methods to understand the weather patterns. Even today, we can see some old people accurately predicting rainfall seeing the clouds and observing the direction of wind. They even surprise us by saying whether it is going to be a heavy downpour or just a drizzle. Some even predict the climate by recognizing the birds, insects and animals behaviors. But what makes it so essential to monitor the changes in the climate? The answer is very simple – to live in a better and safe way.

Why Monitor Climate?

**To Live In a Better and
Safe Environment**

The Earth is so big and when we analyze very carefully, we can see that every country or region has its own way of constructing houses depending upon the climate. Even the crops that are cultivated are based on the climate prevailing in those regions. Right from clothing to the food that we intake,

everything is based upon the climate. We human beings have always adjusted ourselves to the prevailing climatic conditions in order to have a blissful life. Monitoring the changes in climate is not something new and we have been following this from a very long time. The only difference is that, today we have high-end technologies to predict even the minute changes in climate that too for a lengthy timeframe, say, after fifty years or hundred years.

Unlike past, the world has changed a lot today. Climate change is occurring at a faster rate which is not at all a good sign. Humans are interested in understanding climate but at the same time, they are the important cause for creating climate change. As the world is undergoing many changes, it is vital to monitor the alterations in the climate in order to lessen its impact socially, economically and environmentally.

Many industries such as tourism industry are highly dependent on climate and monitoring the climate provides the business owners with the data that is required for planning their operations to cope up with the climatic variations in an effective way. For example, receiving information on the occurrence of heat waves, heavy rainfall, flooding, droughts, hurricanes or typhoons is very much useful considering the damage that they might create to the tourists as well as to the locals who are involved in the tourism business (Figure 8.1).

Why Monitor Climate Change?

- Tells you what is happening on the ground
- Provides data for testing model projections
- Provides data for additional modeling
- Provides feedback on effectiveness of your conservation actions
- Allows course corrections to your management activities



Figure 8.1: Why monitor climate change?, (Source: <https://www.slideshare.net/NationalWildlife/mawdsley-monitoring-climate-change>).

The climatic variation does not only hit the tourism industry; it also has a propounding impact on everything. Let us understand this through some examples. First, let us take droughts. Droughts cause a major setback to the affected country. It can cause reservoirs and lakes to dry. Agriculture takes

a severe hit resulting in shortage of food and increase in food prices, famine and all these will even sometimes lead to political turmoil. There will be non-availability and at the same time poor quality of drinking water which causes health hazards in humans. Bushfires and dust storms occur more often during dry seasons threatening the lives of people and also animals (Figure 8.2).



Figure 8.2: Goats and sheep starved to death due to drought in Kenya, (*Source: <http://www.monitor.co.ke/2015/08/08/climate-change-posing-tremendous-health-threats-humans/>*).

Drought is one example of a climate change and we can see its worst impact. The other climatic events like rain, heat waves, and cyclones, etc., also bring in similar effects. And due to the increasing global warming, these occurrences are more often and severe than before. The climate of our planet is changing at a fast pace and there are more evidences to prove this claim. Various scientists are continuously monitoring the Earth and carefully studying its changing climatic behaviors. They find the below facts as proof to claim that the climate change is real and is happening (Figure 8.3):

- We have already discussed about droughts. Whenever an imbalance occurs between evaporation and precipitation, droughts occur. It is the result of rising temperatures.
- Carbon dioxide level is found more in the atmosphere than they have ever been in hundreds of millions of years. According to the calculations for Year 2014, Carbon dioxide made up 81% of the total greenhouse gas emissions in United States.
- Temperature is another major factor that drives all other phenomena like typhoons, droughts, hurricanes, and wildfires and it is always on the increase.
- The ice caps in the polar region are the perfect indicators of climate change. These ice caps have been in existence for millions of years and they are shrinking now. The polar ice caps are a great cooling agent to the Earth as they reflect sunlight. The shrinking of ice caps is fastening the global warming process and also increases the sea level.
- Another factor that grabs the attention of scientists is the Global Mean Sea Level (GMSL). Increase in sea level is the result of melting of ice and warming of oceans. Global Mean Sea Level and rising temperature are very much linked to each other. According to the Scientists, sea levels have been constantly rising throughout the 20th Century which has made the coastal regions risky and more vulnerable to flooding.
- Oceans are observing more heat and so they become warmer. When the surface temperature of seas becomes higher, more water vapor is formed. Most of the extreme weather events occur when there is more atmospheric water vapor.

Figure 8.3: Proof for climate change.

We can see that there are numerous climatic events occurring that too at a rapid speed. This makes it clear that monitoring of climate is of vital importance. Climatic changes must be monitored so that the government and other business organizations can plan and implement necessary mitigation and adaptation policies. For example, when heat waves attack and cause severe harm to humans, the leaders would want to know whether it is a one-time occurrence or a frequent one so that they can come up with better plan to manage the impact.

8.2. HOW IS CLIMATE CHANGE MONITORED?

The above section clearly elaborated the need for monitoring climate change. Almost everyone on this planet will accept the fact that monitoring climatic change will only bring good. Earth can be saved from destruction only if an effective plan is laid out to adapt to climatic changes. We will also be able to reduce the change from happening, only, if we know the statistics of climate change. Hence getting data on climate variations becomes very important (Figure 8.4).



Figure 8.4: GIS students and professors of Columbia University with balloons used to aerially collect data, (Source: <http://www.ciesin.org/news.jsp?year=2017>).

The advancement in science and technology has made monitoring of climatic variations much easier than before. In the past, balloons, kites, and airplanes were used to monitor climate. Today the increasing number of satellites with specialized sensors, orbiting the planet and marine datasets have turned out to be a boon to the scientific community as they monitor the climate from hundreds of thousands of miles.

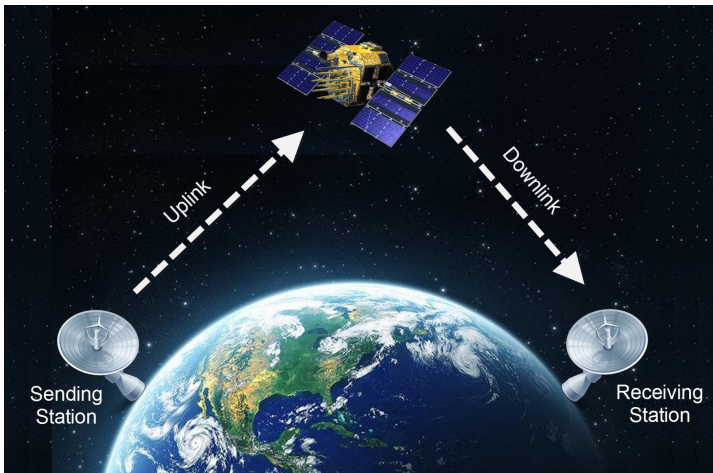


Figure 8.5: Satellite orbiting earth, (Source: <https://www.youtube.com/watch?reload=9&v=AUuNB0nA5Tg>).

Thermometers, rain gauges, and other instruments are also used to record weather. Automated networks of scientific instruments help in

monitoring weather throughout day and night. These tools or instruments are very much efficient in detecting real-time global climatic readings which are used internationally. The data thus obtained enables scientists to analyze the climatic situations and impacts if any and share the same with the government officials to make better-informed decisions.

Meteorological satellites remain to be an invaluable asset to monitor and understand climate change for more than 30 years and their contribution seem to grow increasingly over the future generations. Above hundreds and thousands of kilometers above the Earth's surface, these satellites are working continuously to help scientists predict any abnormalities in the climate. The first weather satellite was first launched in 1959 and thereafter, satellites have become a vital tool of importance (Figure 8.5).



Figure 8.6: Earth radiation budget satellite, (Source: <https://serc.carleton.edu/details/images/139517.html>).

In 1984, it was the Earth Radiation Budget Satellite that helped finding out the hole in the Ozone layer and gave an alarm to the world as to how human activities such as burning fossil fuels affect our planet. Based on this finding, the Orbiting Carbon Observatory mission provided the first global map of

Carbon dioxide concentration around the world after two decades. The European Space Agency's (ESA) Sentinel-3A launched from Russia's Plesetsk Cosmodrome is a recent addition to the family of satellites and the main purpose of this satellite is to thoroughly track sea-surface temperature and also map the extent and topography of ice (Figure 8.6).

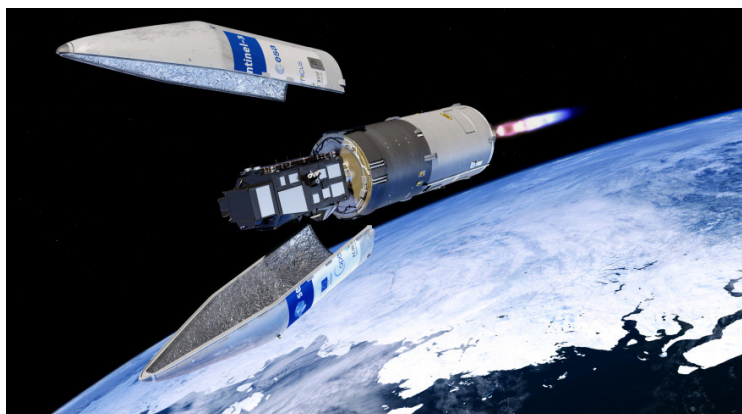


Figure 8.7: Europe's Sentinel-3A earth observation satellite, (Source: <http://spacenews.com/europes-sentinel-3a-earth-observation-satellite-successfully-launched/>).

According to the data provided by the World Meteorological Organizations NASA and NOAA, there are nearly 162 satellites orbiting the Earth's surface either in operational or in semi-operational position. Not every country can afford a climate satellite. Many satellites are operated by various agencies around the world with international collaboration. China, India, and the U.S. are some of the countries that have the most number of climate monitoring satellites. To see from outside Europe may not seem to participate more in activities related to climate change but, according to the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), Europe is one of the key players when it comes to climate satellite research.

Huge amount of money is spent on satellites and when Dr. Simon Keogh, Head of the Satellite Data Products and Systems Group at the Met Office was asked about it, this is what he said,

“Satellites have certain advantages in terms of the global picture, the completeness of the dataset, the way that the data is unaffected by human practice on the ground, for example...Satellites give us this unrivaled global view of what's happening everywhere. The biggest problem with other

kinds of measurements is the coverage: what's happening in the southern oceans, what's happening in the southern hemisphere generally in sparsely populated areas where nobody's making any observations, what's happening in the Arctic and Antarctic."

Briefing on Sentinel-3A satellite, Dr. Simon Keogh further stated that, "Sentinel 3 will have an unrivaled capability for measuring sea-surface temperature from space, and land surface temperature from space. We actually haven't had a satellite delivering this kind of precision for a number of years now, which creates a data gap in the sea surface temperature record, and it's imperative that we make that gap as short as possible by getting Sentinel 3 operational."

The number of meteorological departments and weather-observing stations has been on the increase across the world. The United States alone has thousands of official weather stations. Apart from this, there are many volunteers who record weather data every day by their own effort. We can see many volunteers chasing hurricanes and storms in television and social media. Some of the weather stations where data on climate is collected are listed below:

- National Weather Service Offices (NWS).
- Cooperative Observer Weather Stations (COOP).
- Automated stations at airports maintained by the Federal Aviation Association (FAA).
- Automated Surface Observing System (ASOS).
- Automated Weather Observing Stations (AWOS).

8.2.1. Origin of Weather Recording

Initially, the climate explorers documented their daily weather readings in journals and logbooks. Since many weather monitoring instruments came into the market and there was improvement in communication and data recording methods, people started working in groups to collect weather data and shared it among them (Figure 8.8).



Figure 8.8: Weather recordings in logbooks, (Source: <http://slideplayer.com/slide/10489357/>).

During 1800s, an Army physician ordered his soldiers to collect weather data. Soldiers across the country observed the weather every day as instructed by the army physician and sent the recorded weather to a central location. This practice continued for more than twenty years and in 1891 this task was transferred from the military to a civilian group which later became an agency which is now known as National Weather Service (NWS) (Figure 8.9).



Figure 8.9: National Weather Service at the hurricane center in Miami, (Source: <http://www.wbur.org/npr/589845319/national-weather-service-forecast-cloudy-with-a-chance-of-budget-cuts>).

Climate change is tracked by monitoring certain Essential Climate Variables (ECVs) and these variables are categorized under groups such as air, land, and water (ocean). Scientists and government officials felt the need for storing all the climate readings and weather records in one place. Hence the National Centers for Environmental Information (NCEI) was formed in 1951 (Figure 8.10). All the handwritten logbooks to computer tapes that were used in the early times can be found at this center. Efforts are being made to digitize them and most of them are done and now public has easy access to these data through the internet.

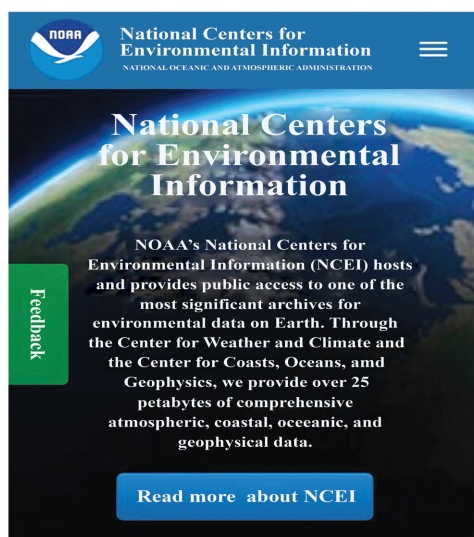


Figure 8.10: All about National Centers for Environmental Information (NCEI), (Source: <https://twitter.com/hashtag/ncei>).

Arriving at climate data has its own challenges. Every climate monitoring device such as satellites or any other instruments will possess its unique sensitivity towards Earth signals. Also for receiving data, calibration and algorithms will be continuously improved over the course of mission. Hence a simple concatenation of data in time will show a vast difference when a satellite is changed and this data cannot be used as it is for climate analysis. In order to arrive at homogenous time series of measurements, across successive satellites that can be used to study climate variations, re-calibration and cross-calibration are a must.

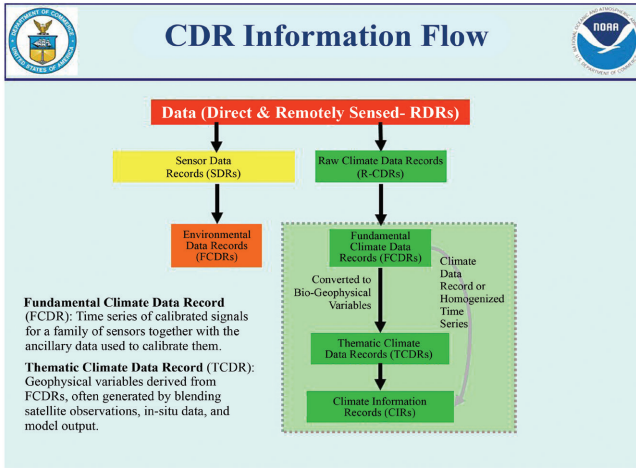


Figure 8.11: Climate Data Record Information flow, (Source: <http://slideplayer.com/slide/7981368/>).

It is only after these calibration processes, the data can be reprocessed into basic physical measurements known as Fundamental Climate Data Records (FCDR). These FCDRs forms the base for climate analysis from which Essential Climate Variables (ECV) can be reprocessed to form Thematic Climate Data Records (TCDRs), which can then be validated against independent climate data. These climatic data can be then used in any way as required (Figure 8.11).

8.3. DIFFERENT CLIMATE POLICIES

Climate change is one of the most critical challenges that the world faces today. The impacts of climate change are endless and another threatening factor is that the impacts are unpredictable in scale. If no proper action is taken today, the world might not get another chance to repair the damages caused. Even if we get another chance, we would have to work from scratch. In order to lessen the danger and work towards a more climate-friendly planet, leaders and environmentalists from across the globe have joined hand-in-hand and have designed many policies to be followed and practiced by all nations. Let us now look into some of the important climate-related policies and their importance:

8.3.1. The UN Intergovernmental Panel on Climate Change (IPCC)

The World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) jointly formed the Intergovernmental Panel on Climate Change (IPCC) to make it as a source of scientific information. The IPCC was formed in 1988 to access and review the scientific information globally related to climate change. The IPCC has called for a reduction in emissions to limit the increase in global temperatures by 2 degrees Celsius (Figure 8.12).

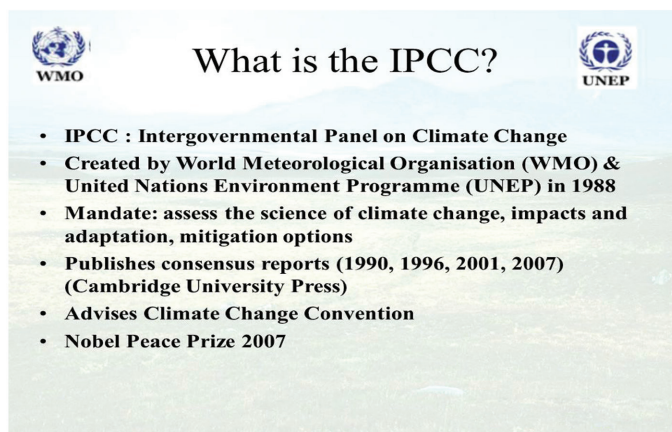


Figure 8.12: What is IPCC?, (Source: <http://slideplayer.com/slide/797728/>).

Periodical assessment reports released by IPCC synthesize global data on climate change. There will be no discussions on climate change without the reports from the IPCC and the estimates are so precise that it is used in setting up benchmarks for international action. The Fifth Assessment Report released by the IPCC is of great significance as it deeply analyzed climate change and said that the climate change is real and that human activities are the main cause for it. The IPCC also releases reports on carbon capture and technology transfer occasionally.

As all other organizations, the IPCC also went under criticism. IPCC was blamed for not revealing the entire risk of climate change and that its reports are politically influenced. But some said that they create much bigger picture of the issue than reality. Also, IPCC was blamed for following long and bureaucratic approval process in this new age of science. This practice may tend to bias the IPCC conservatively. The legitimacy of IPCC

was questioned after a series of scandals relating to its method of reporting leaked out. In order to regain its reputation, the IPCC introduced institutional reforms in May 2011.

8.3.2. United Nations Framework Convention on Climate Change (UNFCCC or FCC)

Most of us would have heard about the United Nations Conference on Environment and Development (UNCED) which is also known as the Earth Summit held in Rio de Janeiro from Jun 3 to Jun 14, 1992. It was a great effort by the United Nations family and the first step in addressing the climate change problem. The UN family is always in the forefront and makes conscious efforts to save the planet. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty signed at this conference.

The main objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system and it aims to prevent dangerous human interference with the climate system.

The treaty did not set any limit on the greenhouse gas emissions for individual countries. Hence the treaty is considered legally non-binding. But the treaty does have updates called 'protocols' that sets mandatory emission limits. 'Kyoto Protocol' is the main update which was referred to as UNFCCC itself (Figure 8.13).

UNFCCC VS KYOTO PROTOCOL

- The major **distinction** between the Protocol and the Convention is that while the Convention **encouraged** industrialised countries to stabilize GHG emissions, the Protocol **commits** them to do so.

Figure 8.13: UNFCCC vs Kyoto protocol, (Source: <https://www.slideshare.net/khairunnisamohammad1/kyoto-protocol-autosaved>).

The UNFCCC came into effect on Mar 21, 1994, and as of May 2011, this treaty was supported by 197 countries. The parties of the convention met every year from 1995 in the Conferences of the Parties (COP), to assess the progress in dealing with climate change. As the main objective of the convention was to reduce greenhouse gas emissions, UNFCCC asked the signatory nations to establish inventories of greenhouse gas emissions and removals. The United Nations Climate Change Conference in 2010 made

an agreement stating that the future global warming level must be limited to below 2.0°C (3.6°F) as was in pre-industrial period.

8.3.3. Kyoto Protocol

As we saw, the UNFCCC does not have any limitation on the emissions, but, only to reduce the emissions. So, the parties of the UNFCCC met to discuss on the ways to achieve the objective and these discussions led to Kyoto Protocol. The Kyoto Protocol sets emissions targets for developed countries which are binding under international law (Figure 8.14).



Figure 8.14: Kyoto protocol countries, (Source: <https://knappily.com/article/5a8736ecaa5fb37f2c3600c7>).

The Protocol was adopted in 1997 and became effective on 16 Feb, 2005; it legally binds developed country Parties to emission reduction targets. The Kyoto Protocol helps countries reduce their emissions by providing three flexible mechanisms as stated below: –

- The Clean Development Mechanism (CDM) – This mechanism allows industrialized countries to invest in climate-friendly projects in poor countries and in exchange earn carbon credits.
- The Joint Implementation Mechanism (JI) – Through this mechanism, the industrialized countries can invest in climate-friendly projects in other industrialized countries and in exchange earn carbon credits.
- The third and the last mechanism is that emissions trading create

a market for trading carbon credits with countries that are over their target.

Many international efforts have been taken to reduce carbon emissions and these efforts have jointly led to the creation of the UN Program on Reducing Emissions from Deforestation and Degradation (UN-REDD). The highlight of this program is that financial assistance is provided for poor countries to protect their forests, as deforestation is considered to be one of the reasons for Carbon dioxide emissions. However, the Kyoto Protocol did not build any mechanism for conservation or prevention of deforestation to mitigate climate change. The only support that the Kyoto Protocol provided was that it provided countries with financial and credit support, that too after the trees were cut down but no support was given to prevent them from cutting down forests.

The first commitment period of the Kyoto Protocol lasted from 2008 to 2012 and the second commitment period runs from 2013 to 2020 and is known as the Doha Amendment to the Protocol, which has not entered into force. The number of countries that participated in the 1st Kyoto commitment was much more than the number of countries that participated in the second commitment. The Protocol has 192 countries in it. Some of the member nations such as Belarus, Kazakhstan, and Ukraine have stated that they may withdraw from the Kyoto Protocol or not put into legal force the Amendment with second-round targets. Japan, New Zealand, and Russia have participated in Kyoto's first-round but have not taken on new targets in the second commitment period.

As of July 2016, 66 states accepted the Doha Amendment, while entry into force requires the acceptance of 144 states. Since the Kyoto Protocol's second commitment ends in 2020, many conferences were held to conclude on the next plan of action and this resulted in the Paris Agreement of 2015 which is a separate policy under the umbrella of UNFCCC and it is not an amendment of the existing Kyoto Protocol. Although it was agreed to extend the Kyoto Protocol until at least 2017 as well as solidified an operating structure for the Green Climate Fund, little was clarified concerning the form of a successor accord to the Kyoto Protocol.

The main drawback of the Kyoto Protocol is that it focused only on developed countries; even in that, it did not include United States. Also, the withdrawal of Canada from the accord was another strain. The statement released by the Environment Minister of Canada made sense that 'Canada could only be a part of an accord which includes all major emitters as

parties.’ This stand taken by Canada set an example as other countries such as Japan and Russia seemed to follow the footsteps of Canada.

8.3.4. The Paris Agreement

The Paris Agreement is very significant as it is for the first time all nations of the world have come together for a common cause of combating climate change and work on the plans to adapt to the effects of climate change. The Agreement abides to support the developing countries also in their effort. The Paris Climate Conference was held in Dec 2015 and the Paris Agreement is considered to be the first ever legally binding global climate deal which was adopted by 195 countries. The Paris Agreement was approved by consensus vote on December 12, 2015 (Figure 8.15).



Figure 8.15: Leaders at the Paris climate conference, (Source: <http://pdaction.org/support-the-paris-climate-agreement/>).

The main aim of the Paris agreement is to maintain the rise in global temperatures of this Century to less than 2°C and to limit the increase in temperature further down to 1.5°C. The Paris Agreement does not specify any number for global gas emissions. Rather it encourages all the countries to cut on their greenhouse gas emissions as soon as possible and to achieve carbon neutrality in the second half of the century.

Every country is asked to set targets in their Nationally Determined Contributions (NDCs). The NDCs are purely voluntary commitments set by nations of their own interest. It should be mentioned that even before the

conference started, 186 countries submitted their action plans for 2025 and 2030. Responsibility vests with the nations in reviewing their pledges and come together every five years starting from the Year 2018, to understand how far they were able to reach their goal. The governments of all nations agreed to have a robust transparency and accountability system in tracking the progress. Unfortunately, the results so far are not convincingly good.

The governments also agreed to strengthen the ability of nations to deal with the climatic change impacts. The developed countries agreed to provide continued and enhanced support to the developing countries in adapting to the climate changes. The agreement acknowledges the need for action and support in different areas such as early warning systems, emergency preparedness, and risk insurance and also recognizes the importance of addressing loss and damage associated with the adverse effects of climate change.

The Paris Agreement came into force on Nov 4, 2016. This agreement sorted out an important issue of the refusal from the developing nations to be considered equal to the developed world as they believed that countries in the North are highly responsible for increasing Carbon dioxide in the atmosphere. The first global stocktake of the Paris Agreement is scheduled for 2023. There are different views as how the subject Carbon Pricing was treated in the agreement.

Few say that, although France which hosted the conference tried to put Carbon Pricing on the agenda, it was left out of the agreement but few other parties mention that, particular mention of providing incentives for emission-reducing activities especially Carbon Pricing has been mentioned in the agreement. According to the new agreement, the developed countries will provide \$100 billion a year in climate finance for the developing countries. The financial goal will be reviewed and a new financial goal will be set up by 2025. The European Union has always been in the forefront of combining countries to achieve a global climate deal. The European Union and all other developed countries will continue their support in reducing emissions build resilience to climate change impacts in developing countries. As European Union had a limited participation in the Kyoto Protocol, EU was fiercely working on a coalition between developed and developing countries and this gave the success factor to the Paris Conference. The EU was the first major economy to submit its intended contribution to the new agreement in March 2015. It is already taking steps to implement its target to reduce emissions by at least 40% by 2030.

8.3.5. Effective Long-term Planning

The main aim of all these policies is to monitor the climate change and work to reduce it by adopting certain principles. The ultimate aim of creating policies is that it should be effective and it should have long-term benefit. Effective long-term planning should include both mitigation and adaptation. Although the world leaders work jointly to frame different policies to curb climate change, changing the behavior of individual human beings is the one that will give a long lasting effect. Many individuals do not have enough awareness about climate change and they don't seem to understand the hidden risk in it. The citizens need to be educated on the various mitigation ways.

According to the researchers at the Wittgenstein Centre for Demography and Global Human Capital based in Vienna, there is enough evidence that education, particularly secondary school, is important for reducing vulnerability to climate change. As education brings in desirable results, it was also argued that a part of Green Climate Fund should be spent to promote universal secondary education.

In order to mitigate the climate change impacts, it is wise to list out all the extreme natural calamities and plan new and unique ways for the future. For example, coastal regions must plan for facing the increase in sea level. Let us take the case of Cambodia and Niger – these two countries are expected to face severe damage due to climate change. Some early steps have already been taken to adapt to these changes. In Cambodia, agricultural planning is addressing inconsistent water access through promoting private sector investment and the diffusion of green technologies such as solar water pumps and water-efficient irrigation. In Niger, new varieties of drought-resilient seeds have been disseminated along with training and investment to promote the diversification of livelihoods.

Another effective long-term plan would be low carbon growth. This point must be treated differently in the developing countries since it should not hinder the country's development. The countries should choose wise climate change adaptation instruments. Integrating adaptation into planning serves multiple ends. It offers a means to scale up local adaptation actions. It provides a platform to support and channel private-sector investments. It allows adaptation to be aligned with existing long-term national development plans along with international efforts such as the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction. Long-term low-carbon growth with resilience is the vision of most developing countries.

This vision is best achieved through integration into long-term strategies.

Many developing countries have already started to move in these footsteps. Kenya has come up with a National Adaptation Plan (2015–30) to support integration into national and country-level planning. In the Cook Islands, adaptation and disaster risk reduction have been integrated into the National Sustainable Development Plan (2016–20). Nepal has developed Local Adaptation Plans of Action (LAPAs) to integrate climate change priorities into local planning across the country which is a great job because it is these policies that now serve as a foundation for the development of Nepal's National Adaptation Plan.

Similar to these countries, Denver, the capital city of Colorado has set a goal to reduce greenhouse gas emissions by 10% per capita below 1990 levels by 2020. The city is on the right track in achieving this goal. When the city recognized the potential of harm, that the climate change may bring in to the city's social, economic, and environmental sectors, Denver adopted a separate and supplemental Climate Adaptation Plan. The objectives of the Climate Adaptation Plan are to prepare for the climate change impacts and mitigate the risks associated with the potential impacts of climate change.

Long-term strategies are very important because whatever the policy/agreement may be, the countries get a chance to think thoroughly and understand what the goals and policies mean for their own long-term emissions trajectories. All the current National Climate Plans (NDCs) are only sufficient enough to limit warming to 2.7–3.7°C. Long-term strategies also encourage countries to avoid costly investments in the wrong technologies.

The first six countries that submitted long-term strategies by 2020 are Germany, Mexico, France, Benin, Canada and the United States. Similar to many other plans, the long-term effectiveness of climate plans requires the local adoption and execution of policies, actions, and programs identified in the plan, as well as measuring their success over time. Communities must be prepared to develop and maintain a greenhouse gas inventory or identify a source for this scientific data.

One distinction in climate planning terminology is important: “mitigation” refers to the practice of reducing greenhouse gases, while “adaptation” refers to anticipating and taking action to reduce the adverse consequences of climate change, including those relating to natural hazards risks. An example of a mitigation strategy might be converting public buses to biodiesel or other alternative fuels, while an example of an adaptation

strategy would be adopting a larger setback from flood-prone areas.

Climate plans, also referred to as “climate action plans,” are an increasingly common type of specialized plans developed by local governments to address the challenges of a changing climate. The climate action plans also include strategies to prevent or minimize the anticipated adverse effects of climate change. They are designed to provide a strategic framework to assess, understand, and reduce greenhouse gas emissions, identified as a root cause of climate change.

8.4. PRACTICES TO BE FOLLOWED IN TOURISM INDUSTRY TO ADAPT TO CLIMATE CHANGE POLICIES

We have been continuously hearing that no other industry is this much dependent on climate than tourism industry. The tourism industry is profitable and perishable, if the climate remains stable as how it used to be and any variations in climate can be predicted upfront because for the tourism industry to sustain, travelers should feel safe and must be travel to all places without any disruption. Climate change not only cause harm to tourists but it creates great loss in terms of infrastructure, change in fuel price and commodities, which will lead to the change in the value of destinations. These are the impacts that humans understand clearly and face directly; the impacts that most of the human population are not aware of is the impact on biodiversity, water resources and changes to landscape.

The coastal and island tourist destination are more vulnerable to climate change impacts like sea level increase, hurricanes, storms, floods, erosion, etc., The hotels and resorts in these destinations usually has high volume of guests and they'll not be able to handle any crisis situation caused due to climate change. That too, developing countries in specific, are in poor conditions to adapt to the climate change. Business profit also takes a hit due to the changes in the weather conditions. Winter sports tourism industry which has a special place in the hearts and minds of tourists and athletes is facing real trouble. The survival of winter sports is questionable as there is a decrease in the length of winter season.

But tourism industry can survive if they adapt to the changing climate. Every section of tourism industry has plenty of opportunities that they can adapt, to cope with the climatic changes. As there is a decreasing demand for the winter sports due to lack of snow, tourism companies can go in for

a four-seasons approach and retain the customers by offering activities like indoor sports, trekking and biking in warmer months, and increasing retail and spa offerings for visitors. Let us see some of the climate change adaptation mechanisms that every small sector in the tourism industry can follow:

8.4.1. Climate Change Adaptation Plans for Resorts and Hotels

Hotels and resorts located in the coastal areas are prone to various climate change hazards. Extreme climatic events like massive storm, some of which can be already seen in the Western United States causes great loss to the hotels and much of it are exposed in the areas where there will an impact. It is difficult for the resorts to secure their property casualty insurance for high-risk geographies, and for locations where damage does occur, premiums will skyrocket (Figure 8.16).



Figure 8.16: Sandbags placed to hold BACK the encroaching tide in Ocean Isle beach, (Source: <https://www.alamy.com/stock-photo-massive-sandbags-attempt-to-hold-back-the-encroaching-tide-in-ocean-19717219.html>).

But certainly, there are ways to overcome this challenge. Resort and hotel companies that have a vision for future and the companies that calculates every future risks will build new hotels well above the highest high tide line. They can always store food for emergency situations, have their staffs trained for disasters and revamp the existing infrastructure so that it can withstand any major climatic outbreaks. They would also look for other business opportunities like investing in water-desalination technologies and changing their offerings to visitors that might not depend much on sun, sand and surfing activities.

8.4.2. Climate Change Adaptation Plans for the Airline Industry

The problem that is likely to grow in the airline industry due to climate change is cancellation of flights and re-routing of flights. What airline companies can do is that they can minimize the services to the places that are not in high demand and increase the trips to new travel destinations. They should work closely with technology and detect possible weather-pattern changes and improve their routing.

Tourism is a daily business and due to the day-to-day demands of profitability, many companies do not find time or rather allocate them to solve the yearlong problem. Tourism companies have to identify opportunities for innovation and work hard to mitigate risks. They have to build a calculative approach in the areas where they may see a fall. Surely the climate change is going to impact the operating cost of businesses. Companies need to check on the possible trends related to climate change and plan new strategies to lessen the impacts to their operations.

Disaster Management Planning and Business Continuity Planning are very essential to face any sudden climatic disasters. Tourist destinations also suffer from climate change. In order to manage these challenges, tourist companies should firstly identify as to how the climate will change in their region because this may affect the products and services that the destinations offer to its tourists. Based on these analyses, the tourist companies can plan and make the necessary developments to sustain tourism business in their destinations.

8.5. WORLD LEADERS TAKE ON CLIMATE CHANGE POLICIES

President Trump's announcement of United States withdrawing from the Paris agreement sent shockwaves to the entire world especially because of the fact that climate change issue was given more importance in the cabinet of former President Barack Obama. This statement from Donald Trump officially removed United States from the global leadership position on Climate Change.

As the main player vanished, leaders of other countries thronged in to take up the climate leadership role. Chancellor Angela Merkel of Germany and President Emmanuel Macron of France have vowed that the Paris agreement will flourish without the United States. Canadian Prime Minister, Justin

Trudeau and Xi Jinping, President of China are promoting their countries as climate change champions. The United Nations Secretary-General, Antonio Guterres is doing a great job by integrating world nations together to have a reduced emission levels. Leaders from across the globe are also contributing to the safety of the world by working on climate change mitigations.

Let us see the different views of global leaders on climate change and their share in climate change policy initiatives:

8.5.1. Xi Jinping, President of China

President Xi Jinping has declared that China had taken a “driving seat in international cooperation to respond to climate change.” He indirectly mentioned Mr. Trump by criticizing countries that retreat into self-isolation mode. China has hosted ministerial-level meetings on clean energy and has joined hands with Canada and European Union to lead climatic discussions. Although China is ahead of its Paris target, it still is a greater contributor of Carbon emission. Robert N. Stavins, the director of the Environmental Economics Program at Harvard University shares his views on visiting China for discussion on Climate Change. He says that he saw a dramatic shift in tenor among Chinese officials. He also stated that China appears to move from co-leadership to sole leadership.

8.5.2. Justin Trudeau, Prime Minister of Canada

Canada emerged with new energy after Mr. Justin Trudeau took over as the new Prime Minis, the main one being involved in Climate-related policies. At the Paris global warming talks held in 2015, Mr. Justin Trudeau declared that ‘Canada is back.’ He also stated that, ‘Canada is unwavering in our commitment to fight climate change.’ Canada is taking too many initiatives to achieve its goal on climate change. The Country also hosted a meeting of the world’s largest economies to discuss climate change. Catherine McKenna, Environment Minister of Canada has firmly stated that, “If the U.S. is going to step back, we’re going to step up.” But Mr. Justin is also criticized for having approved bitumen pipelines and liquid natural gas projects in Canada.

8.5.3. Angela Merkel and Emmanuel Macron, Leaders of Europe

It is said that Europe was the first nation to insist on the Paris Agreement but credit went to Obama’s administration. So now as the United States has

withdrawn itself from the agreement, the leaders of Europe have come back to prove their involvement in the global climate change. President Emmanuel Macron of France has invited the American Scientists who are working on climate change to move to France and continue their contribution. Ms. Merkel, Chancellor of Germany took the Climate Change topic at the center of the G20 Summit of the world's largest economies in Hamburg, Germany.

8.5.4. Antonio Guterres, the Secretary-General of United Nations

Mr. Antonio Guterres, former Prime Minister of Portugal is fully determined to make Climate Change is addressed by all nations. He made sure that the topic on Climate Change is brought up during the United Nations General Assembly meeting. He also initiated a small session to discuss climate change and its impact on small islands after several devastating hurricanes battered the Caribbean. Robert C. Orr, the Dean of the University of Maryland's School of Public Policy and a special adviser to Mr. Guterres on climate change, said the United Nations leader was "putting his own stamp" on climate change by hosting a major summit at United Nations headquarters in New York in 2018.

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